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POUCH MANIFEST

TO: Ms. Emma Best, MuckRock News, DEPT MR 61208, 411A Highland Avenue, Somerville, MA 02144-2516		Pouch No. RE 317 768 722 US
FROM: Central Intelligence Coordinator, Information & Privacy Coordinator, Washington, DC 20505		DATE 07/16/2020

ITEM	DISPATCH No.	SUBJECT AND ENCLOSURES
1	F-2018-02677	Request for copies of historical studies of Division 9 of the Office of Science Research and Development. At least one is known to exist, and was fittingly titled Office of Scientific Research and Development , History of Division 19.
		UNCLASS WHEN SEPARATED FROM ENCLOSURES To avoid tracer action, please sign and return copy 1 within 10 days or fax to 703-613-3003

COPY DISTRIBUTION: Copies 1 and 2 to Addressee. Copy 3 is addressor copy. *COPY 1*

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CL BY:
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Central Intelligence Agency

Washington, D.C. 20505

16 July 2020

Ms. Emma Best
MuckRock News
DEPT MR 61208
411A Highland Avenue
Somerville, MA 02144

Reference: F-2018-02677

Dear Ms. Best:

This is a final response to your 27 September 2018 Freedom of Information Act request for **copies of historical studies of Division 9 of the Office of Science Research and Development. At least one is known to exist, and was fittingly titled Office of Scientific Research and Development, History of Division 19.**

We conducted a search of our previously released database and located the enclosed three documents which appear to be responsive to your request.

If you have questions regarding our response, you may seek assistance from CIA's FOIA Public Liaison at 703-613-1287.

Sincerely,

Mark Lilly
Information and Privacy Coordinator

Enclosures

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Available

6/17/98

OFFICE OF SCIENTIFIC RESEARCH & DEVELOPMENT

HISTORY OF DIVISION 19

VOL. I OF III

Special Reports
Div. 19

SECRET

OFFICE FOR EMERGENCY MANAGEMENT
NATIONAL DEFENSE RESEARCH COMMITTEE
OF THE
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

HISTORY OF DIVISION 19

JUNE 30, 194[illegible]

COPY [illegible] OF [illegible] COPIES

SECRET

SECRET

Colonel Leers, OSO — 14 April 1950

Dr. H. M. Chadwell, OSI

Information on History of Division 19, NDRC

1. The two copies of the History of Division 19, NDRC, that are being forwarded to you were received by me through the kindness of [redacted], R & DB. These particular copies are numbered two and three, and were originally sent to Dr. John B. Conant as Chairman of NDRC, and to Dr. James P. Baxter, III, Historian of OSRD. They were delivered to [redacted] I understand, by [redacted] of the Archives as a result of arrangements made by Dr. Lothrop during his last visit to the Archives. [redacted] whose connections with the R & DB will be terminated in about a month, has told me he is surprised that these volumes of history were in the Archives, because he remembered that Dr. Bush had expressed the personal feeling that this information should not be in that depository. [redacted] duties in the R & DB, which had to do with OSRD matters, will be under the jurisdiction of [redacted] During OSRD days [redacted] served in the Administrative Secretary's Office.

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2. I have been told that these volumes have been sent on loan for a year, with the understanding that the period may be extended, and presume that Archives records show the two copies charged to me.

3. I am sure that you will find this compilation of information to be of great value.

SECRET

January 1, 1946

Dr. Vannevar Bush, Director
Office of Scientific Research and Development
1530 P Street, N.W.
Washington, D. C.

Dear Dr. Bush:

You will remember that in the original planning for Summary Technical Reports for NDRC and Dr. Baxter's history of OSRD it was decided that Division 19 of NDRC should not be included in either compilation. This was based upon your feeling that the program carried out primarily for the Office of Strategic Services should be brought to the attention of a minimum number of people. Consequently, Dr. Lothrop, Technical Aide to the Division, was requested to prepare a composite report to you. This he has done in a most satisfactory way. You will recognize that this undertaking was of considerable magnitude. The story which Dr. Lothrop has written is enlightening and readable.

I hope that you will be able to peruse this volume, because I feel that you will derive great personal satisfaction from reviewing the activities of one of the Divisions in which you have taken a personal interest.

I have reviewed Dr. Lothrop's "History of Division 19, NDRC," and I am glad to submit it to you with my approval.

Very truly yours,

[redacted] (b)(6)

Harris M. Chadwell
Chief, Division 19

OFFICE FOR EMERGENCY MANAGEMENT
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
NATIONAL DEFENSE RESEARCH COMMITTEE

HISTORY OF DIVISION 19

by

Warren C. Lothrop, Technical Aide

NOTE: Since the preparation of the final manuscript, all problems covered in this volume have been reclassified to Restricted, with the following exceptions: SAC-5 (Secret), SAC-6 Paul Revere (Confidential), SAC-22 (Secret), SAC-34 (Confidential), and SAC-37 (Confidential).

Copy 3 of 7 Copies

Distribution:

Copy 1 - Dr. Vannevar Bush, Director, OSRD
Copy 2 - Dr. James B. Conant, Chairman, NDRC
Copy 3 - Dr. James P. Baxter III, Historian, OSRD
Copy 4 - Director, Strategic Services Unit, Research and Development Division, War Department
Copy 5 - Brigadier General E. A. Regnier, War Department Liaison Officer for the NDRC
Copy 6 - Rear Admiral H. G. Bowen, Chief, Office of Research and Inventions, Navy Department
Copy 7 - Division 19 Files

"Yea, stranger engines for the brunt of war
Than was the keel at Antwerp's bridge
I'll make my servile spirits to invent."

Scene I, "Dr. Faustus," by Christopher Marlowe.

ACKNOWLEDGMENT

The author wishes to acknowledge the cooperation and assistance of a number of persons without whose interest and help this volume could never have been prepared. The following individuals deserve special thanks: Dr. H. M. Chadwell, for his reading and criticism of the subject matter; [redacted] (b)(3) CIAAct (b)(6), for her patience and untiring devotion to the difficult job of transcribing the original notes and later the finished volume; [redacted] (b)(3) CIAAct (b)(6), for her assistance in the original transcription and collection of many of the photographs; [redacted] (b)(3) CIAAct (b)(6) for the preparation of a number of tables of reports and assistance in assembly; [redacted] (b)(3) CIAAct (b)(6), for her early survey of the files and preparation of the first draft of part of the history; [redacted] (b)(3) CIAAct (b)(6) for the preparation of special illustrations; and Lt. Col. John M. Jeffries, for supplying the necessary copies of many of the pictures.

It is hoped and believed that all who had part in the activities of Division 19 can feel proud of the results and take pleasure in the distribution of this volume.

[redacted] (b)(6)

C
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P
Y

OFFICE OF STRATEGIC SERVICES
Washington 25, D. C.

18 July 1945

Dr. J. B. Conant, Chairman
National Defense Research Committee
1530 P Street, N. W.
Washington, D. C.

Dear Dr. Conant:

With the recent termination of the work of Division 19 I am reminded again of the debt which we owe to Dr. Chadwell and the distinguished group of scientists under his direction. Their unfailing cooperation and assistance made possible much of the developmental work undertaken by this agency and contributed in many ways to the success of our operations.

I am glad to have this opportunity of reiterating our appreciation of all that Division 19 and the other members of your organization have done to facilitate the work of this agency.

Sincerely yours,

/s/ Charles S. Cheston

Assistant Director

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ORIGIN, COURSE, AND END OF DIVISION 19

On March 27, 1942, Dr. J. B. Conant, Chairman of NDRC, at the request of Dr. James P. Baxter, III, authorized Dr. H. M. Chadwell, Technical Aide of Division B, to make informal contact with Lt. Col. Preston Goodfellow, who was responsible to Colonel William J. Donovan, at that time Coordinator of Information. It appeared that Lt. Col. Goodfellow was anxious to set up a scientific liaison with OSRD, and accordingly a meeting was arranged on April 8 between Lt. Col. Goodfellow, Dr. Chadwell, and two British representatives assigned to Colonel Donovan.

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[redacted] one of these British representatives, met again with Dr. Chadwell on May 6, 1942. He and his superior, [redacted] were interested in developing and producing in this country equipment for the use of Commandos and establishing a research laboratory. It seemed likely that the latter activity might be a proper function of OSRD.

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As a result of this meeting, Colonel Donovan on May 7, at the suggestion of Dr. Baxter, formally requested the active cooperation of OSRD with his organization and with the two British representatives. Dr. Bush replied on May 13 accepting the arrangements and delegating Dr. Chadwell as his representative. This was accepted by Colonel Donovan on May 15 with the designation of Lt. Col. Goodfellow and Lt. Col. Williams as his representatives.

Section B-9-C

With the clearance given by this exchange, NDRC representatives in Division B formed the nucleus of a group who were equipped by background, technology, or imagination to serve as a research committee. This came into being in May 1942 as Section B-9-C composed of Dr. Roger Adams, Dr. G. B. Kistiakowsky, and Mr. S. P. Lovell, with Dr. H. M. Chadwell and Dr. W. C. Lothrop acting as Technical Aides.

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Throughout the summer months, conversations were held with the British representatives on matters connected largely with sabotage and subversive warfare, and two contracts were begun under Section B-9-C [redacted] During this period the effectiveness of the group was hampered by the extreme secrecy and "cloak and dagger" atmosphere engendered by the liaison officers. An example of the extent of this can be found in the fact that the work at Columbia was allowed to proceed for many months without the revealment to the contractor or to the Technical Aides of the purpose of studying the

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action [redacted], the system of the Pencil time delay, a device which was then in production in England in large quantity and had already fallen into the hands of the Germans by capture. The absurdity of carrying on in this sub rosa manner was realized very early but was not corrected until the fall of 1942.

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In July, [redacted] who was at that time stationed in London in the Liaison Office representing the Chemical Divisions of NDRC, opened a liaison with the British Interservices Research Bureau office, who had sent [redacted] to this country. This eventuated as will be seen below in a change of liaison and in an end to the aura of mystery.

It should here be noted that ISRB operated under the name of Secret Operations Executive (SOE) in British Security Co-Ordination in this country.

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On July 14, a meeting with [redacted] and B-9-C membership outlined still further research required, especially on the Pencil and incendiary devices. These requirements were expressed in the name of the Office of Strategic Services which had just come into being, and it was stated that [redacted] and [redacted] were functioning as technical assistants to Col. Goodfellow. Also discussed were train wrecking, time delays, silencers, radio-operated switches, and secret communication. It was decided that Dr. G. B. Kistiakowsky, who was soon to travel to London, would further clarify the situation with Professor [redacted] the technical director of ISRB.

On August 10, 1942, Dr. Adams wrote to Dr. Conant that some twelve separate proposals had been received from OSS for research but that he and his group, Section B-9-C, were not satisfied with the established arrangements. He suggested that Dr. Bush might wish to clarify the set-up.

It developed, as a result of Dr. Hogness's and Dr. Kistiakowsky's conversations in England, that [redacted] second to Professor [redacted] would visit this country, and on August 20 Dr. Bush wrote to Dr. James Grafton Rogers, assistant to Colonel Donovan, proposing further conversations on the liaison. On September 1, 1942, Dr. Bush was informed by Colonel Donovan that [redacted] SOE had arrived in this country, and on September 3 he met in Washington with Dr. Bush and Dr. [redacted] head of the London OSRD liaison office. It was decided that [redacted] should work through OSS and that he and the [redacted] would discuss with the British Central Scientific Office ways of putting problems to OSRD.

Pending clearance of these channels, on September 2, 1942, and on September 4 in New York and in Washington, B-9-C met to discuss details of the technical program. Present at these meetings were: Dr. Adams, Dr. Kistiakowsky, Dr. Kharasch, Mr. Lovell, Dr. Chadwell, Dr. Lothrop, [redacted]

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Director's Subcommittee

On September 30, Brigadier General J. R. Dean, secretary for the Joint Chiefs of Staff, wrote to Dr. Bush requesting "such cooperation with your organization as you find practical and consistent with other responsibilities which you have undertaken for the Armed Forces." Dr. Bush replied on October 2 accepting the relationship and extending collaboration to OSS. In this letter it was suggested that a "single highly reliable individual be named by OSS as the sole liaison for that organization." In reply to this suggestion, Colonel G. E. Buxton, Assistant Director of OSS, informed Dr. Bush, on October 6, that Mr. Stanley P. Lovell would resign his position as Technical Aide in Division B to become their representative, and on October 13 Dr. Bush appointed Dr. Chadwell as his representative with OSS and as Chairman of the Director's Subcommittee for Cooperation with Special Government Agencies. This was followed on October 19 by the appointment of Mr. Lovell as "Special Consultant to the Director of OSRD." At this time it was also arranged that [redacted] (b)(3) CIAAct (b)(6) other liaison officers of SOE would channel their requests to NDRC through Mr. Lovell.

On October 21, the first meeting of the Director's Subcommittee, soon afterwards known as the "Sandeman Club" (SAC), was held with the full membership present, namely: Dr. H. M. Chadwell, Chairman, Division B; (b)(3) CIAAct (b)(6) [redacted] Division A; [redacted] Division C; [redacted] Division D; and [redacted] Chairman's Office. (b)(3) CIAAct (b)(6) Dr. W. C. Lothrop acted as Technical Aide and was appointed secretary to the Committee on October 30. The composition of the above-named committee insured the presence of personnel familiar with the whole program of NDRC, and facilities and technical knowledge of all NDRC Divisions were thereby put at the disposal of OSS.

The Director's Subcommittee was set up under unusual procedures at the request of Dr. Bush. Projects were to be submitted directly from Mr. Lovell to Dr. Chadwell and were to receive the approval of Dr. Conant and Dr. Bush personally. The Committee was provided with its own budget originally approved by NDRC in the sum of $352,000 to carry the Committee to August 31, 1943. This money was to cover contracts which would be administered by the Divisions of NDRC through a joint relationship with the Committee, which at that time had no contracts under its sole and direct control. The members of the Committee would, however, bear the major responsibility for technical overseeing of the work, and the separate Divisions would be kept informed through their chiefs. Reports, however, would be kept at a minimum and would not go through the usual Army and Navy liaison channels. It was decided that one copy would be sufficient to deposit with the Executive Secretary of OSRD, this to be delivered through Dr. Bush.

The Committee was specifically excused from preparing the usual monthly and bi-monthly summarizing reports required by NDRC of the other Divisions, and it was authorized to handle its own Service tests and records. The

ideas of all the Divisions of NDRC were verbally solicited by the members of the Committee but the exact nature of the activity, at Dr. Bush's request, was kept as closely held as possible. The extent to which the other Divisions cooperated was remarkable, and before the end of activity Divisions 1, 2, 3, 8, 9, 11, 13, 14, 16, and 17 had been of assistance, as well as the Tropical Deterioration Committee, the Office of Field Service, the Committee on Medical Research, and the Engineering and Transition Office.

Division 19

By March of 1943, it appeared that a broader liaison with the regular Army and Navy would be desirable; such a suggestion was made, and at the same time Dr. Chadwell proposed to Dr. Conant a reorganization of the Director's Subcommittee as a Division of NDRC to be known as the Division of Miscellaneous Weapons. This suggestion was approved on April 2 by NDRC and on April 9 Dr. Bush appointed the following personnel: Chief, Dr. H. M. Chadwell; Members, [redacted] Dr. G. B. Kistiakowsky, and [redacted] and Technical Aide, Dr. W. C. Lothrop.

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In June 1943, after discussions between the Army, Navy, OSS, and OSRD, liaison was established with the older Services and Division 19 had assigned to it in the Office of the Navy Coordinator of Research and Development Lt. Bruce Old, later replaced by Lt. John T. Burwell, Jr., and in the Army liaison office, Captain M. W. Miller.

From this time until the end of the Division on June 30, 1945, it functioned almost exclusively as the research and development group for the Office of Strategic Services, whose functions are quoted below (from OSS General Order No. 9—January 3, 1943):

> "The Office of Research and Development is responsible for the
>
> 1. Invention, development and testing of all secret and special devices, material and equipment for special operations, and the provision of laboratory facilities.
>
> 2. Sole liaison with the OSRD and with other related government departments on technical matters."

It will be seen by perusing the separate problems described below that a number of these were initiated during the period of Section B-9-C but were not formalized and undertaken aggressively until the establishment of the Director's Subcommittee. This group, which functioned for approximately six months, initiated a number of contracts and laid the groundwork for the rapid expansion which took place after the formation of the Division.

Once the Division came into being and had its regular liaison established with the Army and Navy, it continued in a way similar to the other Divisions but under the special rules of secrecy which have been described above. Divisional meetings were held regularly once a month, and new problems were received at irregular intervals, eventually to the number of fifty-two. These problems were considered of sufficient magnitude to be given special designations, but in addition to these more formal requests, OSS made many small requests which were in the nature of testing, proving, and demonstration of devices and development of small gadgets requiring chiefly ingenuity.

Work under the Division was carried on with increasing tempo in the summer of 1944, by which time many of theproblems had been satisfactorily carried through the research and development stages. The feeling became widespread among those involved in the program that with the progress of the European war the need for this type of research had diminished due to the liberation of conquered Europe and the lack of an underground movement in Germany.

It was also felt that the large fields of opportunity in this type of warfare had been well explored. The Division through its program had worked on silent weapons, secret means of communication, sabotage devices for the interruption of transport, and specific ways of attacking railroads, automotive vehicles, airplanes, and ships. Techniques for the use of high explosive and fire by saboteurs and guerillas had been developed and an arsenal of some 25 weapons had been put into the first stages of production and use. Moreover, there was a third pertinent consideration at that time. This was the different type of warfare which prevailed in the Far East, where the services of conquered peoples count not be so completely relied upon as in Europe.

For the three reasons given above, it was the general consensus of opinion that the work of the Division should be gradually decreased. This feeling was confirmed at the NDRC meeting of January 12, 1945, when it was decided jointly between NDRC and OSS that Division 19 should terminate on June 30. Throughout its existence Division 19, including its preceding forms, had allocated to it by NDRC a total of $2,406,500, of which a sum roughly estimated at $400,000 was probably not spent.

Maryland Research Laboratories

It was very early recognized that the Division was in need of a central laboratory which could take care of numerous small matters and which would have a permanent staff of competent scientists with the facilities which they required to be of continuing service. In June of 1943 this laboratory was established near Washington under a contract with [redacted], and located in a wing of the Congressional Country Club, which had been leased by OSS for other purposes. In this ideal location a number of excellent investigators were assembled and from its beginning until it was finally transferred in toto to OSS the laboratory proved to be a nucleus for the Division, cooperating with the other contractors, taking on and solving suitable research problems, devising and carrying out extensive tests, etc. So valuable was this service that it was the only contract

of the Division which OSS felt it desirable to assume at the time when Division 19's termination was planned. The detailed services of this laboratory, the Maryland Research Laboratory, or more familiarly known as MRL, will be more fully described later in this history.

U. S. Service Relationships

While the Division had its contacts with the Army and Navy, in general these were not formalized and very few problems were submitted to the Division by the older Services. These few are also discussed below, and it will be apparent in the various discussions of the separate problems that many devices which were developed for OSS came to be of interest to other branches of the Services. It may be said that this rather informal arrangement worked quite well on the whole and relieved the Division personnel of the countless burdens of reports and administrative detail with which other Divisions had to grapple. If it had not been for this irregular procedure, it would have been manifestly impossible to accomplish all that was accomplished with the limited number of people engaged.

It should be noted also that OSS consistently adopted the attitude of helpfulness toward other Services, and on any occasion when a device developed for them appeared of interest to another group they were most cooperative in seeing that it was adequately presented and in assisting in its Army and Navy adoption.

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In general the work of the Division did not undergo any remarkable change in character as the war progressed. The problems first posed [redacted] OSS remained essentially the problems of the Division throughout its existence. At the start, as will have been observed from the account of the origin of the Director's Subcommittee, there was a certain atmosphere of secrecy and mystery about the purposes and objectives of OSS and their British liaison. This was dispelled in the course of time to the great advantage of the work, and by the spring of 1943, the true nature of the requirements of OSS and SOE had become clear to the Division personnel with consequent speeding up of the solution of these problems.

British Liaison

With the fall of France and with the British weakened by the blow of Dunkirk, the morale of the Allies everywhere was at a low ebb. At that time the British felt that one cheap way to boost this morale would be to supply the conquered countries with simple devices which could be used to annoy and harass the Germans. An arm of this activity, and the one which was most spectacular in the public press, was Combined Operations, whose spectacular Commando raids along the coast line kept the Germans in ferment and the hopes of the conquered countries alive.

The branch of British Security Co-Ordination known in this country as SOE was charged with operating within the interior of conquered Europe, and it was their function to build up and supply and eventually to lead the forces of the underground. This required the development of suitable devices, and the Interservices Research Bureau was established by the British to provide these needed weapons. This organization was semi-military in character and operated a number of Stations throughout the United Kingdom, where work of one kind or another was carried on by specialists throughout the war. These Stations were remarkably successful in developing and producing a variety of equipment suitable for the use of Commandos, saboteurs, spies, and guerillas, but in spite of this success, they felt the need for American assistance, and this was the origin of the mission of [redacted]

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These gentlemen came to America with a two-fold purpose. Their main object was to secure American production of devices which they had already developed, such as the Pencil, and which were required in numbers beyond the capacity of the manufacturers in England. Their other and perhaps more incidental purpose at the time was to establish contacts with research groups in America with the object of expanding here in the research program already initiated in England. That they succeeded in both of these objects is to their credit and to the good fortune of the United States.

Until their arrival here, America was entirely unprepared for this kind of warfare. The Office of Strategic Services had not been established, operations if any were at a minimum, and in general the whole peacetime philosophy prevailed that this type of activity was, to say the least, un-American. After Pearl Harbor and after the establishment of OSS, American activity along these lines became possible and under the encouragement and guidance at the start [redacted] and the more experienced British, a significant research program got underway with success.

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With the program once launched and with the greater resources of American science and technology behind it, it was carried through with remarkable speed and with the very close functioning of the three groups: SOE, OSS, and NDRC. Throughout this period the presence in this country of permanently assigned senior British officers with their wealth of background and experience greatly speeded the progress. It may be said, however, that these officers, in the opinion of the writer, had greater vision and imagination than the people who had sent them, and it thus resulted that many devices which had been developed at the request or suggestion and with the cooperation of the British failed to reach them in any significant numbers due to the short-sighted and niggardly policy of headquarters in London. OSS on the other hand, and America thereby, profited, for many of these devices became standard American stores.

Relationship to the Course of the War

Let us now turn to the effect which the progress of the war had upon the work of the Division. It has already been said that at the start of

American activity the interest was in developing simple foolproof devices for harassment and sabotage and this remained the chief work of the Division throughout its existence, with such items as Silencers, Pocket Incendiaries, Caccolube, and Fireflies being developed.

At the Allies became stronger and the danger of successful German invasion of Britain diminished, activities on the continent increased somewhat in scope. Commando operations were intensified and were on a large scale, while Allied officers were dropped into occupied Europe in increasing numbers and the underground began to stir. With these happenings, weapons of another sort were required. These were for the use of organized groups of operators rather than for individuals who of their own volition and without superior direction performed acts of sabotage. These organized groups, called "coup de main" parties, could be entrusted with techniques and devices more complicated than those previously mentioned as suitable for general dispersal. As a result, work was intensified on such items as Limpetry, Anerometer, Mole, and Abalone. These specialized devices were augmented by a research service operated in England by the British under which each raiding party or group was provided with tools especially devised for the specific targets under attack. So far as the writer is aware this activity never became an American one, although it was attempted without fruition under a project called "Bull's Eye."

With the approach of D-Day, stores for the underground were rapidly increased and the dropping of supplies by air in France, Norway, Yugoslavia, and Greece, to mention the more important countries, was greatly expanded. These stores were not only the two types already mentioned, but in addition occasioned a need for a third type; this is exemplified by the problems on Mortar and Rocket, both of which were items of some size and effectiveness and might be called guerilla weapons.

Even though the last two categories of weapons were allowably larger, more complex, and more complicated to operate, the emphasis was still upon simplicity and foolproofness, and continual striving for these ends greatly lengthened the development period and delayed the day of use, while of course producing a more perfect and better product. Whether a happy medium between these two conflicting aims resulted is hard to say. In hindsight it would seem perhaps that perfection had been too dearly bought.

In addition to secret operations requiring devices of the kind mentioned above, a function of our liaison groups was the gathering of secret intelligence, and it was for their purposes that problems were submitted calling for special easily destroyed paper and notebooks such as Balsam and Moth, as well as secret communication devices exemplified by the IFT and Sky Wave.

Following D-Day and the rapid liberation of France, Belgium, Greece, and Yugoslavia, the need for all types of subversive devices greatly diminished; there were no longer customers in any large numbers, and attempts to organize an underground in Germany did not have time to bear fruit.

This period coincided with the completion of a great deal of the research program and the feeling among some connected with it that the chief targets available with this type of warfare had already been successfully attacked.

By this time OSS had begun to operate in the China-Burma-India theater, an operation which continued with remarkable success prior to the campaign of General Stilwell resulting in the reconquest of Northern Burma. These operations were expanded also into China, Indo-China, and Thailand but were not of a nature to require further new research.

Because the devices developed previously for Europe had been made carefully, it was expected that they would withstand the heat and humidity of the tropics. Most of these stores became available at once, and there were few unique problems posed as a result of the shift of operations from the West to the East. To be sure there were some, and these were exemplified by the Teak, Zephyr, and Aqua Vita problems, all of which had reached conclusions by the end of the Division on June 30, 1945.

Above and beyond these, it was anticipated that OSS would have numerous small problems submitted from the field, problems of insufficient magnitude or technicality to require the continued existence of a special Division within NDRC and the use of a large number of contracts with scientific laboratories. For these reasons, and after due consideration over a period of months, it was unanimously agreed between NDRC, OSS, and SOE that the Division's work should be considered as complete and that it should wind up its affairs in an orderly manner. This decision was formalized at the meeting of NDRC on January 12, 1945, when Mr. S. P. Lovell and Mr. C. S. Cheston, Deputy Director of OSS, appeared; arrangements were begun for the transfer to OSS of the central laboratory, whose usefulness has already been outlined, and this was accomplished by April 30, 1945.

No further comment is required on the details of the demobilization of the Division. It was accomplished as planned, and it is safe to say that those who were connected with it may look back with satisfaction upon a period of rich accomplishment and of two years of activity which all believed will be of permanent value to this country in future emergencies.

GLOSSARY OF CODE NAMES AND DEFINITIONS USED IN DIVISION 19

Abalone – The name given SAC-3, the problem concerned with methods of attachment of Limpets and explosive charges (SAC-3).

Adams Plan – The suggestion of Dr. L. S. Adams that bats bearing incendiaries be liberated near Japan either from submarines or airplanes (SAC-6).

Adhesive – Limited to those materials used for the attachment of explosive charges above water on all matter of surfaces (SAC-3).

Anerometer – A barometric fuse responding to an altitude change of roughly 1500 feet and temperature and shock insensitive (SAC-27).

Arson – The problem of instructing personnel in the use of fire (SAC-6).

Aqua Vita – The problem of producing pleasant-tasting, sterile water in the field from contaminated sources (SAC-51).

Aunt Jemima – A mixture of RDX or HMX and flour having the properties of plastic explosive (SAC-16).

Balsam – A paper readily destroyed by mastication but resistant to natural humidity and able to receive all types of writing (SAC-43).

Barney – A glass cloth jacket for covering outboard motors (SAC-52).

Bat – An alternative name for the Adams Plan (SAC-6).

Beano – A baseball hand grenade, both high explosive and white phosphorus (SAC-28).

Belcher – Chemicals which when introduced into water supplies in parts per billion render the water nauseating and undrinkable without being poisonous (SAC-44).

Bigot – The adaptation of the spigot mortar principle to a .45 caliber automatic (SAC-13).

Big Joe – The rifle size Penetrometer (SAC-13).

Black Joe – High explosive camouflaged as coal (SAC-30).

Blackout - High explosive electric light bulb initiated by the passage of electricity (SAC-20).

Brimstone - The general name for incendiary problems (SAC-6).

Bulls Eye - The application of scientific and special devices to specific targets named by OSS.

BURP or BRP - British Urgent Railway Plan for the derailment of locomotives (SAC-10).

Bushmaster - Three types of time delay rifle and machine gun simulators for harassing and deceiving purposes (SAC-33).

Caccolube - The destruction of motor vehicles by the introduction of chemicals into the oil or fuel supply (SAC-9).

Camel - The code name for camouflage (SAC-30).

Campbell - A method of quickly sinking and firing an explosive laden boat.

Canister Locater - A device to enable reception parties to locate at night stores dropped by air with parachutes (SAC-4).

Cannon - An assassin's pistol (SAC-7).

Casey Jones - Attack on railroads in general (SAC-10).

Clam - A magnetic explosive charge equipped with time delays for attacking steel targets (SAC-3).

Clockwork - Precise waterproof clockwork delays (SAC-17).

Cluck - A communication device, MWT (SAC-4).

Cricket - The ultimate in compact radio receiver-transmitter (SAC-37).

Dog Drag - A device for throwing bloodhounds off the trail of an agent (SAC-50).

Dragon - A gun firing a dart by means of gas pressure (SAC-46).

Dropping - The term usually used in reference to supply by air of ground forces.

Emily Post - The code name given SAC-18 dealing with poisons.

Facsimile - A method of transmitting by wire reproductions of documents (SAC-34).

Fantasia - Development of fantastic and psychological ideas for the purpose of frightening the enemy (SAC-26).

Firefly - An explosive hand-size delay-action grenade which, when introduced in the fuel tank of a motor vehicle, explodes the tank and ignites the contents (SAC-21).

Fountain - A shaped charge and accompanying equipment to be planted in the roadbed of a railroad with the object of destroying the boiler or cylinders of a locomotive (SAC-10).

Hedy - A device to create panic in a crowd without contravening the Geneva Convention (SAC-23).

Honeymoon - The code name for work on time delays (SAC-17).

Hooter - An underwater noise maker (SAC-4).

IFT - Induction Field Transceiver - An electro-magnetic device for short range secret communication (SAC-4).

IFL - Induction Field Locater - An electro-magnetic transmitter on which men equipped with IFT can home (SAC-4).

Impact Testing Machine - The code name for SAC-1, a silent weapon throwing a dart propelled by a spring.

Joe Louis - The largest size penetrometer capable of throwing grenades or small mortar cells (SAC-13).

Lacrima Tojo- The use of liquid explosives disguised as innocent materials such as lubricating oil (SAC-40).

Limpetry - The problem of underwater attack on steel and wooden ships (SAC-42).

Little Joe - A pistol model of the Penetrometer and the prototype (SAC-13).

Locomotive - A code name sometimes given to the problem SAC-10.

Locust - The code name of SAC-39 calling for the sabotage of high precision machinery by contamination with small amounts of chemicals.

Lost Chord - A code name for SAC-4, the problem of communication, homing, and identification of agents.

Lulu - A disperser-igniter for inflammable dusts (SAC-31).

Matchhead - A waterproof ending to the Pencil made either from celluloid or magnesium and giving silent ignition of incendiary devices (SAC-6).

Maude Muller - Code Name of problem SAC-45 concerned with the destruction of tropical foliage.

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[redacted] Device - An early name used in SAC-2 to refer to radio switch activated by a frequency of 100 kc (SAC-2).

Mark II Pencil - (Sometimes Known as the Perley Pencil) - An electrolytic time delay based on the general design of the Mark I Pencil (SAC-17).

Mole - A photo-sensitive electronic switch developed under SAC-10 for attacking trains in tunnels.

Moth - Readily destroyed brief cases and notebooks based on incendiary or explosive principles (SAC-47).

MWT - Microwave transmitter - A device for secure communication over short distances (SAC-4).

Nemo - The code name for SAC-38, attack on submarines in general.

Odometer - A distance switch developed under SAC-10 to trigger charges placed on a train at a pre-selected spot.

Packaging - The code name for SAC-48.

Paul Revere - PR - An incendiary working both on land and on water and capable of igniting crude oil as well as more combustible materials (SAC-6).

Pencil - A chemical time delay standard with the British and the Engineers (SAC-17).

Penetrometer - A silent flashless weapon throwing a dart and utilising rubber as the propelling force (SAC-13)

PEP - The code name for SAC-24, the transmission of secret messages utilising existing facilities.

Pin-Up - A device to attach limpets to either steel or wooden ships consisting of a nail driven by a propelling charge (SAC-3).

Pocket Incendiary - PI - A celluloid case filled with gelled solvent and equipped with time pencils and matchheads (SAC-6).

Popeye — An electric alarm system depending on trip wires to give warning of the presence of marauders.

Postell — The code name of SAC-22 dealing with a method for the utilization of enemy-controlled telephone wires.

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Rainbow — The code name for SAC-5 on ultraviolet and infrared communication.

Rocket (3.5 SSR) — The 3-1/2-inch spin stabilized rocket of Division 3 for which a rocket launcher was developed (SAC-15).

Saint Michael — A magnetic recorder together with microphone and telephone line input and playback (SAC-29).

Salex — A slow burning explosive composed of sulfur, aluminum, and TNT (SAC-31).

Sandeman Club — The original code name of Division 19 and the origin of the SAC system of numbering.

Shell — Attack on motor vehicles by using cashew nut shell oil (SAC-9).

Shortstop — The code name for SAC-25 on the attack of electrical equipment by subtle means.

Silencer — A device to eliminate muzzle noise from standard weapons (SAC-14).

Simultaneous Events — (otherwise known as SE) — The code name for a radio switch to respond to a selected signal but to be safe from accidental triggering (SAC-2).

Sky Wave — A method of radio transmission in which the antenna is especially located on the ground (SAC-22 and SAC-24).

Sleeping Beauty — A one-man underwater craft developed by the British and used in attacks on harbors and ships (SAC-4).

Sloma — A model of the Penetrometer (SAC-13).

Snail — An alternative name for Pin-Up (SAC-3).

Speedometer — A switch developed under SAC-10 for attack on railway equipment. In this application it is mounted on an axle and activated by centrifugal force.

Spigot Mortar - A silent flashless weapon developed by the British (SAC-36).

SRA - Signal Relay American - The American Time Pencil (SAC-17).

SRI - Signal Relay Incendiary - The Time Pencil equipped with Matchhead (SAC-6).

Suction Cup - The attachment of Limpets by means of rubber suction cups (SAC-3).

[redacted] Bulb - A method of preventing accidental triggering of SE and depending upon evolution of gas by electrolysis in a closed bulb containing dilute sulfuric acid (SAC-2).

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Switack - A model of the Penetrometer (SAC-13).

Sympathetic Fuse- Known to the Engineers as the Concussion Detonator - A device for activating one explosive charge underwater by the firing of another (SAC-10).

Teak - Methods of attacking wooden ships and bridges (SAC-31).

Thwaites Device - An alternative name for Firefly (SAC-21).

Transceiver - An abbreviation for the IFT (SAC-4).

Turtle Eggs - A device for attacking automotive equipment by introducing into the oil system materials which destroy the bearings without arousing suspicion (SAC-9).

TVA - The code name for SAC-49, under which the services of NDRC in performing large scale experiments in North Carolina were provided.

UWT - Underwater Telephony - A device for communicating between Sleeping Beauties (SAC-4).

Varga - A shaped charge to open and set fire to storage tanks of oil (SAC-35).

Veritas - A device giving delayed action firing of signal flares to be dropped by air (SAC-41).

Vitamin Pills - Capsules of a chemical soluble in water undetected by standard methods of analysis and capable of destroying storage batteries (SAC-38).

Wandering Boy - The code name of SAC-48, specifically concerned with homing devices and the location and pick up of agents on hostile shores.

Well -	A self-tapping crucible containing thermit for attack on machinery and metal targets (SAC-8).
Who, Me? -	A harassing device for annoying the enemy by contaminating his person with foul smelling liquids (SAC-23B).
William Tell -	The final model of the Penetrometer of the rifle type (SAC-13).
Wire -	An alloy of aluminum having fair electrical and mechanical properties but rapidly soluble in salt water (SAC-11).
Woodchuck -	A device to wreck a train on a bridge (SAC-32).
Woolworth Gun -	A cheap, impermanent pistol for distribution among conquered peoples (SAC-7).
X-Ray -	The code name for the Adams Plan and more specifically for the time delay developed under that program (SAC-11).
Zephyr -	The code name for the silencing of outboard motors (SAC-52).

ADMINISTRATIVE SET-UP

Division B-9-C (September 2, 1942 - October 21, 1942)

Dr. Roger Adams, Chairman
Dr. H. M. Chadwell
Dr. W. C. Lothrop
Mr. S. P. Lovell
Dr. George Kistiakowsky
(b)(3) CIAAct (b)(6)
[redacted] (informal)

Director's Subcommittee (October 21, 1942 - April 9, 1943)

Dr. H. M. Chadwell, Chairman (Division B)
Dr. W. C. Lothrop, Secretary
(b)(3) CIAAct (b)(6)
[redacted] (Division D)
[redacted] (Division A)
[redacted] (Chairman's Office, NDRC)
(Division C)

Division 19 (April 9, 1943 - June 30, 1945)

Dr. H. M. Chadwell, Chief
Dr. W. C. Lothrop, Technical Aide
(b)(3) CIAAct (b)(6)
[redacted], Member
, Member
Member
Dr. G. B. Kistiakowsky, Member
(b)(3) CIAAct (b)(6)
[redacted] Member
(later), Member
(later), Member
(b)(3) CIAAct (b)(6)
[redacted] Consultant
Consultant

Service Liaison Officers: Lt. Bruce Old, Office of the Coordinator of Research and Development, Navy Department.
Lt. John T. Burwell, Jr., Office of the Coordinator of Research and Development, Navy Department.
Capt. M. W. Miller, Office of the War Department Liaison Officer for the NDRC.

SOE Liaison Officers (in Chronological Order):

[redacted]

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OSS Liaison Officers (Chiefs of Research and Development Branch):

Mr. Stanley P. Lovell
Mr. Franz T. Stone
Lt. H. J. Anderson
Lt. Col. John M. Jeffries

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[redacted]

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(b)(3) NatSecAct

[redacted]

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[redacted]

OSS PROCUREMENT OF DIVISION 19 DEVICES

SAC No.	Name of Device	Amount Ordered
17	AC Delay	
27	Anerometer - Mark I, Mark II	50,918
43	Balsam (Reams)	10,612
33	Bushmaster - Single shot	15
	- Multiple shot	20,000
	- Trap	5,000
9	Caccolube	2,000
17	Clockwork Delay - 12-hour	34,900
	- 24-hour	1,975
50	Dog Drag	250
30	Explosive - Candle	1,200
	- Coal	400
21	Firefly - Small	2,453
	- Large	98,000
23	Hedy	500
42	Limpet	6,092
3	Limpet Placing Automatic	20,024
31	Lulu	3,000
3	Magnetic Holdfast	310
3	Magnets	3,500
10	Mole	267,000
10	Odometer	500
4	Parachute Locater	100
17	Pencils	100
3	Pin-Ups	11,120,000
6	Pocket Incendiary	4,000
15	Rocket Launcher 3.35 SSR	1,000,000
15	Sights for Bazookas	500
14	Silenced Guns - .22	1,000
	- .45, M-3	1,000
	- .380	5,000
36	Spigot Mortar	1,000
10	Sympathetic Fuses	1,500
8	Thermit Well - Large	10,000
	- Small	23,174
23	Who, Me?	10,000
		600

Information supplied by OSS on 30 July 1945.

SAC-1 IMPACT TESTING MACHINE

Operational Background

Throughout clandestine operations there is a need for a silent, flashless gun for the assassination of sentries at ranges up to 50 yards. In many operations it is not desired to kill a man if it can be avoided, since this generally alerts others and results in loss of security; however if it is absolutely essential, then obviously it must be done with a minimum of disturbance. For this reason three different problems were undertaken by the Division to develop a silent weapon: SAC-1, SAC-13, and SAC-14.

General Statement of the Problem

It was desired to develop a spring-activated and therefore flashless silent weapon throwing a projectile equivalent to a 50-caliber bullet with a muzzle velocity approaching 1000 feet per second and having a minimum loading time of 30 seconds.

Historical Background

This problem had an informal beginning before July 1942, when Dr. Roger Adams, in his capacity as chief of Section B-9-C, and Mr. S. P. Lovell, who had recently joined NDRC as a Technical Aide, made contacts with Dr. Karl Compton with a view to determining how feasible this idea might be.

This had followed a suggestion made concretely by Mr. Lovell in June 1942, when he had presented Dr. Chadwell with a sketch of a proposed gun and calculations which indicated its promise. His words of that time very succinctly state the objective:

> "The most valuable asset of a raid is surprise, not only in the outset but if possible maintained surprise. The longer a raid may retain this element the better its chances of success, the fewer its casualties, the nearer its objective; thus maintained surprise may be considered the ace card of the Commando. After it is played, the raid develops into a contest. The technique of stealth clearly points to the development of a noiseless, flashless gun.
>
> "It occurred to me that spring metals had been so perfected in the last decade that a spring recoiled gun might offer possibilities. A mechanical study of the energy necessary indicates that this may well lie within the border of possibility."

Entirely on an informal basis. Dr. Compton initiated a few experiments at [redacted] These appeared sufficiently promising, so that on the Director's Subcommittee recommendation a contract was initiated in Division D [redacted] and dated back to August 1. Upon the reorganization of NDRC the contract was assigned to Division 17, where it remained until transferred in May 1943 to Division 19.

By March 1943 a test model had been constructed having a noise level estimated to be less than a .22 pistol. This laboratory model was perfected in June, firing an arrow-shaped projectile capable of penetrating 1/2-inch wood at 50 feet. The spring when coiled delivered a force estimated at 3000 pounds, and the seriousness of the recoil problem was then recognized. There was also question whether the requirement of rapid reloading could be met.

For these reasons it was felt that the work should be drawn to a close as unlikely to be of value to OSS. The final report was submitted on October 5, 1943, and the problem was considered terminated without constructive results.

Soon thereafter, however, interest was expressed by officers in Cominch, and at the request of Lt. Bruce Old of the Coordinator's Office [redacted] considered in detail whether the type of hollow tubular spring which he had worked out successfully for this device could be used in filling a major requirement for the silent propulsion of 500-gallon cans of gasoline 30 to 300 yards. To cover the expenses of this, the contract was further extended to January 1, 1944.

It appeared from his work that there was no possibility of meeting the Navy requirement, and accordingly the matter was dropped by mutual agreement. Some contribution did, however, result from the contract, for in December 1943 word was received from England to the effect that: "We have examined the [redacted] report with interest and consider that the work carried out has provided most useful data, both theoretical and practical, on springs. In particular, the test apparatus described has immediate application here, and we hope to build one in the future for our own use." The full reports were also made available to Division 2 at the request of Dr. John Burchard, Chief of Division 2 and Chairman of the DOLO Committee, and [redacted] of Division 17. Test apparatus and the hand model illustrated here were dispatched to MRL on January 6 for storage and exhibition in the museum.

Technical Information

In its final form the one and only model made, illustrations of which follow, weighs 7.17 lbs., has an over-all length, including the handle, of 14 in. With twenty-seven turns of the handle the weapon can be fully charged within 30 sec. The estimated velocities with projectiles weighing 0.074 lbs. and 0.150 lbs. are 154 ft/sec. and 137 ft/sec. respectively. The frame was cast from No. 43 aluminum alloy, the barrel and the outside tube were fabricated from Shelby Seamless Tubing, and in order to reduce the weight the spring

hole was fabricated out of No. 17 ST Duralumin. Various miscellaneous parts were machined from drill rod and heat treated with quenching to give them adequate temper and to allow them to withstand the full load.

The chief difficulties were encountered in the preparation of the hollow wire helical springs, which tended to develop hair-like cracks in heat treatment and to break when loaded. A correct heat treatment procedure was finally discovered, and this difficulty was overcome.

A special technique for winding the springs was developed, the tubes being filled at the time with a low melting alloy which after winding was melted out. Some of the resulting springs survived 50 cycles of full service loading and firing without failure.

Various projectiles were developed from which it appeared that those with aluminum vanes were more stable in flight; thus it will be seen that the device reached a fairly advanced stage of research when it appeared for non-scientific reasons impractical.

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__Problem Submitted:__ October 21, 1942. __Problem Terminated:__ January 1, 1944.

__Contract:__ [redacted] Official Investigator; August 1, 1942, to January 1, 1944.

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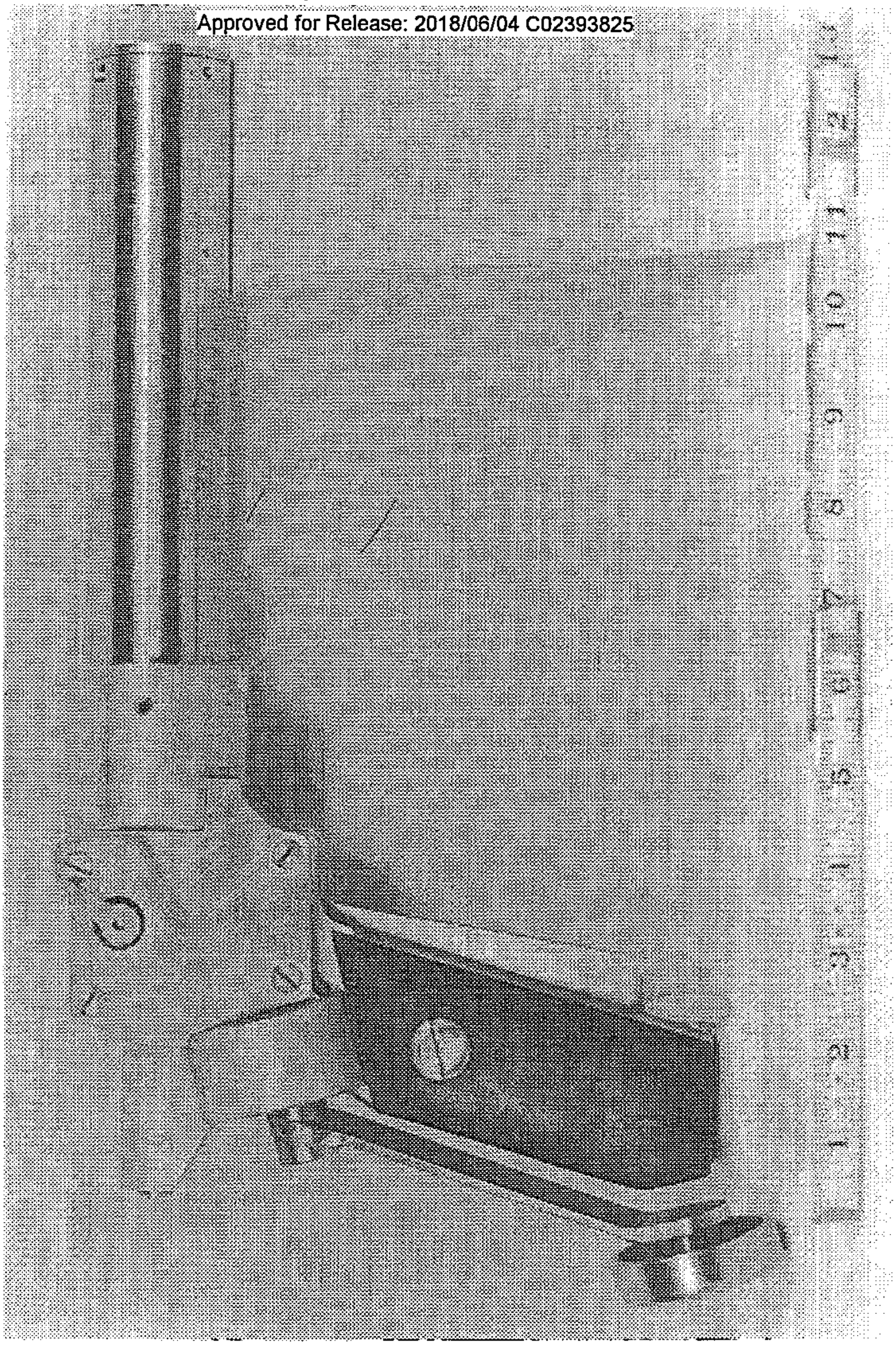
__Final Report:__ Division 19 Serial No. 3 submitted to [redacted] October 5, 1943, with supplement dated December 4, 1943.

__Patent Report:__ Invention report forwarded to Captain Lavender March 8, 1944, on the following inventions: hollow wire helical spring; plunger retracting mechanism; and spiral groove projectile.



Approved for Release: 2018/06/04 C02393825

(b)(3) NatSecAct

SAC-2 SIMULTANEOUS EVENTS

Operational Background

In 1942 the requirement existed for a radio set of very small size to be activated by a central transmitting station at distances up to 500 miles and on activation to set off explosive charges or incendiaries. The operation visualized by those in OSS called for the placement of a large number of these sets simultaneously throughout conquered Europe. Agents would select the most vulnerable spots with the object of causing both terror and material danger. These sets would have sufficient shelf life so that a period of a month or two for distribution would be allowable. They would also be so constructed that they would not respond to the sweeping of the radio bands by the enemy, and thus would not prematurely trigger. At a given time the central station, located in England and broadcasting on a preselected frequency to which the sets were tuned, would transmit a signal of long duration, thus simultaneously firing all sets throughout Europe.

This original operational requirement faded from the picture early in 1943 for reasons best known to OSS. By that time it had been successfully solved from a technical point of view. With the disappearance of the original requirement, a new requirement came into the fore; this called for the development of a radio switch which would be triggered by a transmitter carried in an aircraft. Operationally it was planned that these small radio switches would be planted by agents near targets well in advance of a bombing raid. The approaching aircraft when nearing the target, presumably at night, would trigger the radio switches, initiating signals such as fires and Very lights on the ground and thus guiding them to their target. It was thought that if such a switch could be made compact and with reasonable shelf life it had a real future in the bombing campaign then beginning against the Fortress Europa. This requirement was also solved to a degree.

OSS, in May 1944, proposed a further requirement; this was for a radio switch to be operated by a transmitter located on the ground. This problem was treated entirely separately from the rest of the subject matter and was called SAC-2a. A successful solution to this requirement was also found.

General Statement of the Problem

While the specific operational requirements changed, as indicated above, the general requirements for the device remained the same. The devices were to be capable upon the reception of a radio signal of releasing a

mechanical firing train and thus initiating explosive and incendiary charges. They were desired in the smallest possible size with the maximum possible shelf life and with anti-disturbance and self-destructive features. The last of these was to be accomplished in case triggering had not taken place and the batteries required for continuous operation had expended themselves. The frequencies on which the sets were to operate were variable; the original requirement for Simultaneous Events was accomplished by a frequency of approximately 100 kilocycles; the second requirement, namely the Pinpoint Bombing, was accomplished by approximately 100 megacycles; and the third requirement, SAC-2a, was at a frequency of 3 to 8 megacycles.

Historical Background

1. Simultaneous Events.

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Dr. Roger Adams arranged a conference between Mr. Lovell, then a Technical Aide in Division B, [redacted] of the Signal Corps. This took place on July 16, 1942, and the full cooperation of the Signal Corps was thereby obtained with [redacted] subsequently named as liaison officer. At the suggestion of [redacted] officers, the [redacted] Company was selected as a suitable contractor and was represented throughout the negotiations by [redacted]

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[redacted] The bulk of the work, including the design and construction of models, was the function of the [redacted] however developed a delay mechanism which will be described below and which rendered the radio device immune to the effects of static and enemy sweeping of the air.

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A meeting took place on September 4, at which the definite requirements of this problem and the Pinpoint problem were stated. In attendance were representatives from the British Mission, OSS, Signal Corps, and NDRC.

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On October 9, 1942, [redacted] demonstrated the first complete receiver, incorporating the time delay invented by [redacted] and operating on a frequency close to 100 kilocycles. This device had too short a battery life for practical use and was deficient in some other details, notably size and weight.

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Further meetings took place in December, and on the seventeenth of that month a satisfactory field test was run on this so-called Mitchell Device; it was shown by a practical demonstration that the

unit could be triggered at a distance of at least 30 miles by a radio signal of proper frequency and sufficient duration. The Mitchell Device was rendered safe against accidental triggering by the inclusion in the circuit of an electrolytic cell, the invention of Mr. [redacted] This allowed the delivery of the necessary mechanical energy to fire an explosive train by the passage of as little as 5 milli-amperes for a period of 5 seconds. The details of the [redacted] Bulb" will be found below under the technical discussion.

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It was at this time that the operational requirement which originally existed for this type of device evaporated, and accordingly the Mitchell switch was not further developed.

2. Pinpoint Bombing.

With a shift in emphasis from Simultaneous Events to Pinpoint Bombing, a shift in frequency was also required. In the former case, it will be recalled that the set would be operated at distances up to 500 miles. This requirement was not desired in the second case, where the need was rather for a switch which would be operable from transmitters standard with bombing planes and where a range of operation of approximately 20 miles was considered optimum. Both of these pointed to a charge in frequency to approximately 100 megacycles.

Fortunately through a contact which Mr. Lovell had made with Dr. K. T. Compton in October 1942, some work on a device fitting these requirements had begun at the Radiation Laboratory. This work, under the direction of [redacted] had produced a very small unit which in preliminary tests in November 1942 appeared worthy of further attention.

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Up to this time the Director's Subcommittee and Division 19 had attempted to direct the work themselves, but it became increasingly evident that the subject matter was so technical in fields with which Division personnel were unacquainted that it would be better handled by another Division of NDRC.

In January 1943 a proposal was made by Dr. Chadwell to Dr. C. B. Jolliffe [redacted] both of Division 13, for assistance and direction to the program. This resulted in a meeting on February 9, 1943, attended by OSS, Division 19, and Division 13 personnel, at which it was decided to turn over to Division 13 the [redacted] contract and to base the solution of the Pinpoint Bombing problem on the [redacted] unit described in the Radiation Laboratory report of February 22, 1943 (61-PRB-022243). From that point the program was entirely in the hands of Division 13 and their contractors.

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Further meetings in March and April attended by all the interested parties resulted in the request that [redacted] should build ten models of the [redacted] circuit modified by the inclusion of time

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delays to increase the battery life and such changes as would cut down the re-radiation of the set and make it less vulnerable to sweeping. The latter point was important, since the [redacted] Bulb was not adaptable to use with the new circuit and a different type of delay was required. For this reason the [redacted] contract was allowed to terminate.

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In April and May, attempts to make the device less vulnerable to sweeping included both a pendulum relay and meter movement relay. The latter was finally found to be satisfactory and was incorporated in units decided upon at a meeting in June. Effective as of the first of July, Division 13 entered into a contract [redacted] to assist in the production [redacted] of ten models of this design and to conduct tests. This contract, under the technical supervision of [redacted], became of increasing importance when it was discovered in late August that the tubes which had originally been specified for the unit were not of a type suitable for long life at 100 megacycles.

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(b)(3) NatSecAct
(b)(3) CIAAct
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This lead to the decision in October to reinvestigate the circuit, a function which fell [redacted]. Attempts by [redacted] during this period and up to February 1944 with the cooperation of [redacted] to develop a suitable tube came to naught. With the shift of emphasis to a new model, the [redacted] contract was terminated by Division 13, and [redacted] assumed the entire responsibility for solving the original problem. At the same time, the responsibility for the self-destructive features were handled largely by OSS directly and with [redacted] cooperation.

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(b)(3) NatSecAct
(b)(3) NatSecAct

The Signal Corps, who had been kept fully informed of progress, at their suggestion assigned a formal nomenclature to the unit henceforth known as "Radio Receiver R-37 ( )/CR." So numerous were the various groups who were interested in this development of a radio switch and so diffuse was the responsibility for it in NDRC that a special committee to handle this and other communication problems was decided upon and formally requested by OSS in March 1944.

This committee, known as SACOM, met from that time until the end of the Division in June 1945 at regular intervals and reviewed the work going on on all communication problems (SAC-4, -22, -24, -29, -34, and -37). In attendance were OSS, British, Division 13, and Division 19 representatives.

On a direct order placed by OSS with the [redacted] Company, several preproduction models of the improved [redacted] unit having an entirely new circuit and using two tubes of standard type were demonstrated in April 1944. These operated successfully when triggered by the transmitter in a B-17 bomber at a distance of 8 miles at altitudes of both 1000 and 2500 feet. A second model with a new circuit was developed

(b)(3) NatSecAct

(b)(3) NatSecAct [redacted] in June 1944 but did not supplant the one in semi-production. The latter was so successful that OSS placed an order for 1000 units [redacted] in Chicago. (b)(3) NatSecAct

3. SAC-2a.

(b)(3) CIAAct (b)(6)

On May 12, 1944, [redacted], the OSS liaison officer on communication problems and representative on SACOM, formally requested the development of a radio switch suitable for use with a ground transmitter operating on 3 to 8 megacycles. Division 13 assigned the problem [redacted] in June and their suggestions were forthcoming in a report of the following August which seemed so suitable to [redacted] that a model was requested by him in October. This Division 13 had built under a direct contract which it arranged [redacted] and with the assistance of [redacted]

(b)(3) NatSecAct (b)(3) CIAAct (b)(6) (b)(3) NatSecAct (b)(3) NatSecAct

The first model of this third type of radio switch was demonstrated to OSS on April 20, 1945, with numerous changes requested by them. With the end of Division 19 on June 30, 1945, SACOM was disbanded and further work on SAC-2a was maintained directly between Division 13 and [redacted] At that time it appeared that a successful solution to the problem would soon be at hand.

(b)(3) CIAAct (b)(6)

Technical Information

1. Simultaneous Events.

a. The Mitchell Device.

This consists of a shielded metal box 6x9x4 in. with an insulated 6x9x5/16 in. loop attached by clips to the outside of the metal container. A partition inside the box isolates the radio chassis from the battery pack. The total weight, including 2 lbs. of batteries, is approximately 8 lbs., and the frequency selected is 113 kilocycles. Because of sensitivity to the surrounding noise level, it was decided that the operator should determine this variable feature prior to planting the set and simple means are provided for accomplishing this. Also, the set is provided with a booby trap arrangement so that once located it cannot be disturbed without firing a charge of plastic explosive contained within the set.

By experiment it was determined that the field strength from the transmitter should be not less than 100 microvolts/m at the location. Six or seven days of continuous operation was the maximum expected. A loop tuned to the operating carrier frequency of the transmitter and located in a field of sufficient strength applies a voltage on the grid on the first radio-frequency amplifier stage. Another stage following this increases the amplitude of the carrier voltage sufficiently to reduce the bias on the direct current amplifier, thus causing plate current to flow in the output resistor. The negative

voltage across this resistor is applied to the grids of two radio frequency amplifier stages, which in turn reduces the plate current of the two tubes.

Since the B battery current passes through the relay coil as long as there is less than the field requisite strength in the loop, the bias obtained across the resistance and the amplifier tubes is low and their plate currents keep the relay armature open. However, as soon as the field strength increases above 100 microvolts/m., the resultant decrease in amplifier plate current causes the relay armature to close the battery circuit to the [redacted] Bulb. So long as the requisite signal is being received in the loop, current will pass through the [redacted] Bulb and, as will be described below, will actuate the mechanical firing mechanism.

(b)(3) CIAAct (b)(6)

b. [redacted] Bulb - The Willard Electrolytic Cell.

(b)(3) CIAAct (b)(6)

This consists of a glass spherical bulb of approximately 1/2-in. diameter containing dilute sulfuric acid, an air bubble of pre-determined size and sealed platinum electrodes. When mounted in the radio set, it is held by sockets under an applied tension of 5 to 8 lbs. in the horizontal axis. When the relay of the set closes, as described above, a direct current of approximately 5 ma passes through the [redacted] Bulb between the platinum and electrolizes the dilute sulfuric acid. This reaction causes the evolution of hydrogen and oxygen gas, which as the current continues to pass accumulate in the air bubble and increase the internal pressure of the bulb eventually to the breaking point.

(b)(3) CIAAct (b)(6)

When this occurs, the tension supported by the Bulb is suddenly released and the usual train of mechanical firing is initiated. The bulbs as produced by Willard had a rather high temperature coefficient so that, depending upon the ambient temperature of the radio switch, a continuous signaling would be required by the transmitter of anywhere between 3.4 sec. at 100° F. and 20 sec. at -10° F.

Safety against sweeping is assured, since sweeping is never of such duration. In practice it was found that the bulbs were very sensitive to the thickness of glass and to the size of the air bubbles, but the contractor successfully standardized the method and large-scale production might have been feasible had it been required.

Full details of the device were disclosed [redacted] in March 1944 and [redacted] in May 1943. [redacted]

(b)(3) NatSecAct
(b)(3) NatSecAct

2. The Pinpoint Bombing.

a. The [redacted] Device.

(b)(3) CIAAct
(b)(6)

Experience with the control of model airplanes in flight indicated that a super regenerative circuit would be suitable to provide a unit of the desired size and shelf life. The original model measured 3-1/8x5-3/4x2-13/16 in., had the antenna contained within the case and adapted for receiving vertically polarized waves.

"The circuit employed a gas-filled triode type QF-6 operating as a super-regenerative detector at about 90 megacycles. A relay in the plate circuit of the detector directly operated the detonator circuit and in addition a 2-v. 60-m.a. pilot lamp connected on the relay side of the safety switch." The latter is to inform the operator whether the equipment is functioning properly before the safety switch is closed. So long as the plate circuit relay is kept closed by the plate current of the detector, the detonator circuit is open. There is also provided a pick-up switch so that lifting the box 1/36 in. disconnects the relay and fires the detonator. This is also accomplished when the plate battery or filament battery becomes exhausted. A received signal also causes the plate current of the detector to decrease and allows the relay to close in the detonator circuit.

It was the QF-6 tube which was later found to fail at the frequency selected, a fact which was not at all surprising when it was learned that this tube was meant to operate at 60 megacycles.

b. The [redacted] Model.

(b)(3) NatSecAct

This switch closes an electric circuit when actuated by a radio signal which is tone modulated at a predetermined audio-frequency. This radio frequency is capable of adjustment between 1600 and 2300 cycles. Sufficient time delay and audio-selectivity are provided, so that false operation by voice modulated signals and noise are unlikely even under extreme conditions of interference.

The antenna is a short vertical wire 5 in. long. The experimental model measures 6-3/4x3x3 in. and weighs approximately 2-3/4 lbs. with battery. The essential circuit consists of two tubes, the former a conventional super-regenerative detector (Type 957) and the second (type 1S5) with both a diode and pentode section.

"The diode is used to rectify the audio output voltage from the detector. The d.c. voltage so obtained biases the grid of the pentode section negatively and reduces the current in the plate support to a small value. Thus the relay normally held inoperative by the no-signal plate and screen current of the 1S52 is released when the tone modulated control signal is received."

A time delay of the order of 250 milli-seconds is provided, since the detector load impedance is an anti-resonant circuit, so that the switch will not operate unless the moderated tone falls within a prescribed narrow range of audio-frequencies. The production type varies slightly from the above description but is essentially the same in details of circuit.

(Throughout this volume, references quoted are from the appropriate final reports.)

3. SAC-2a.

The [redacted], in attacking this problem, were aware of the considerable interference to be expected from the general noise level, especially during thunderstorms, and had therefore to devise a circuit which would not respond to these interfering signals. It was also necessary that the receiver should have a considerable gain because of the poor efficiency obtained with short antennas in this range and because of the relatively low signal strength available for operating the switch. (b)(3) NatSecAct

The transmitter specified operates on CW only and has a power output rating of 5 to 15 watts. Its antenna is normally used as a wire about 50 ft. long, either vertical or inclined depending upon available support.

The receiver devised [redacted] is based on a 5-tube circuit and is believed to meet most of the specified requirements. The complete circuit comprises a converter, an intermediate frequency amplifier, a detector audio-frequency amplifier, a limiter, and a rectifier DC amplifier. The circuit following the limiter is similar to the 1S52 rectifier DC amplifier and relay employed in the SAC-2 unit described above. The volume of the device is estimated to be approximately twice that of the SAC-2 switch (79 cu. in.) and somewhat greater than the SCR-536 Handie-Talkie. (b)(3) NatSecAct

Problem Submitted: October 21, 1942. Problem Terminated: June 30, 1945.

(b)(3) CIAAct
(b)(6)

Contracts: [redacted] (b)(3) NatSecAct
[redacted] official investigator; August 10, 1942, to May 10, 1943.
[redacted] (b)(3) NatSecAct

(b)(3) CIAAct
(b)(6)

[redacted] official investigator; August 1, 1942, to February 29, 1944. This contract was started under Section B-9-C, was transferred to Division 11 on March 30, 1943, and was transferred from that Division to Division 13 on May 19, 1943; the contract was terminated under that Division.

(b)(3) NatSecAct

[redacted]; Mr. M. L. Almquist, official investigator; July 1, 1943, to May 15, 1945. This contract was initiated by and was entirely under the jurisdiction of Division 13.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

OEMsr-1434 with [redacted] official investigator; to August 31, 1945. This contract was also entirely under the jurisdiction of Division 13.

(b)(3) NatSecAct

(b)(3) CIAAct
(b)(6)

Final Reports: Division 19 Serial No. 1, Contract [redacted] was submitted to [redacted] on August 16, 1943.

(b)(3) NatSecAct

(b)(3) CIAAct
(b)(6)

Division 19 Serial No. 10, Contract [redacted] was submitted to [redacted] on May 16, 1944.

Section 13.4 distributed the final report on Contract [redacted] in October 1945.

(b)(3) NatSecAct

(b)(3) NatSecAct

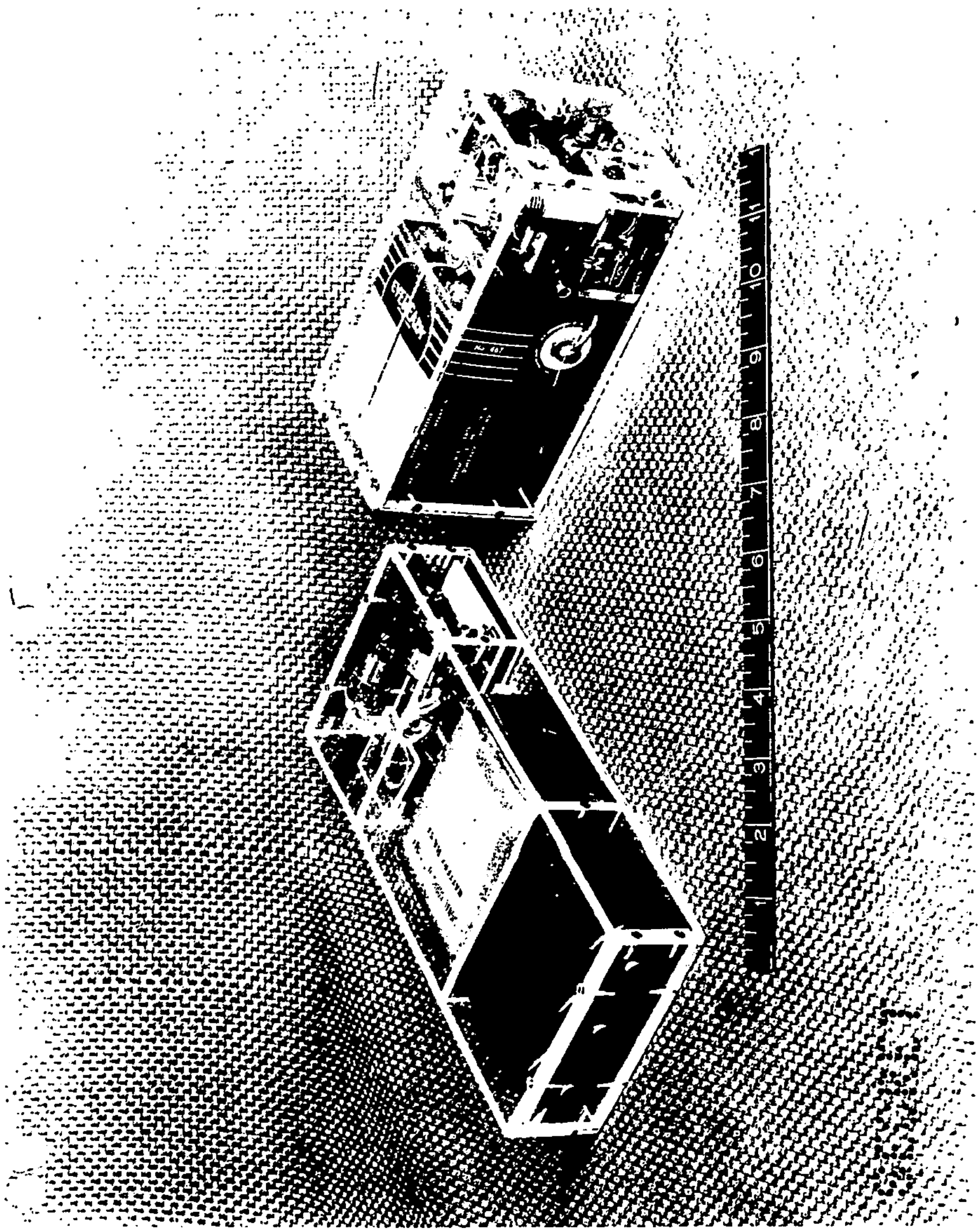
The final report on Contract [redacted] had not been distributed on the termination of Division 19.

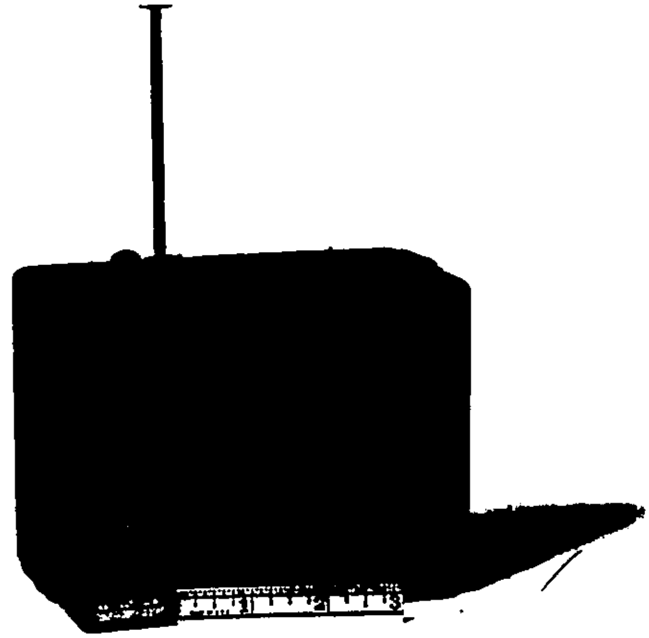
(b)(3) NatSecAct

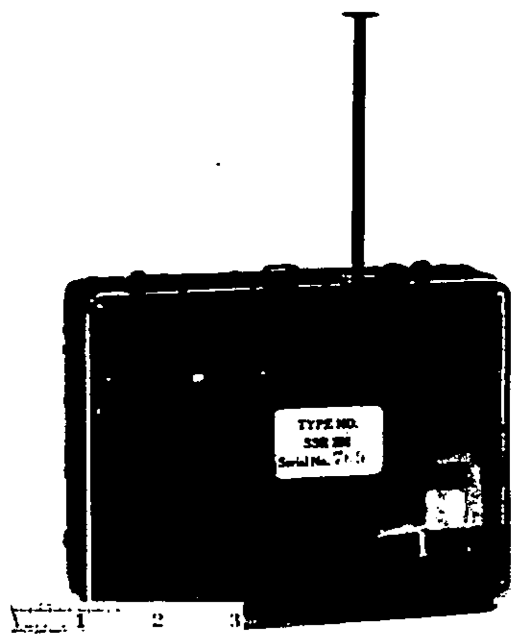
(b)(3) CIAAct
(b)(6)

Patent Reports: The [redacted], Contract [redacted], was sent to [redacted] on November 27, 1943, and was later patented by the Navy on December 9, 1944, as Serial No. 567,515.

It was arranged that patent matters of the other contracts would be reported by Division 13.



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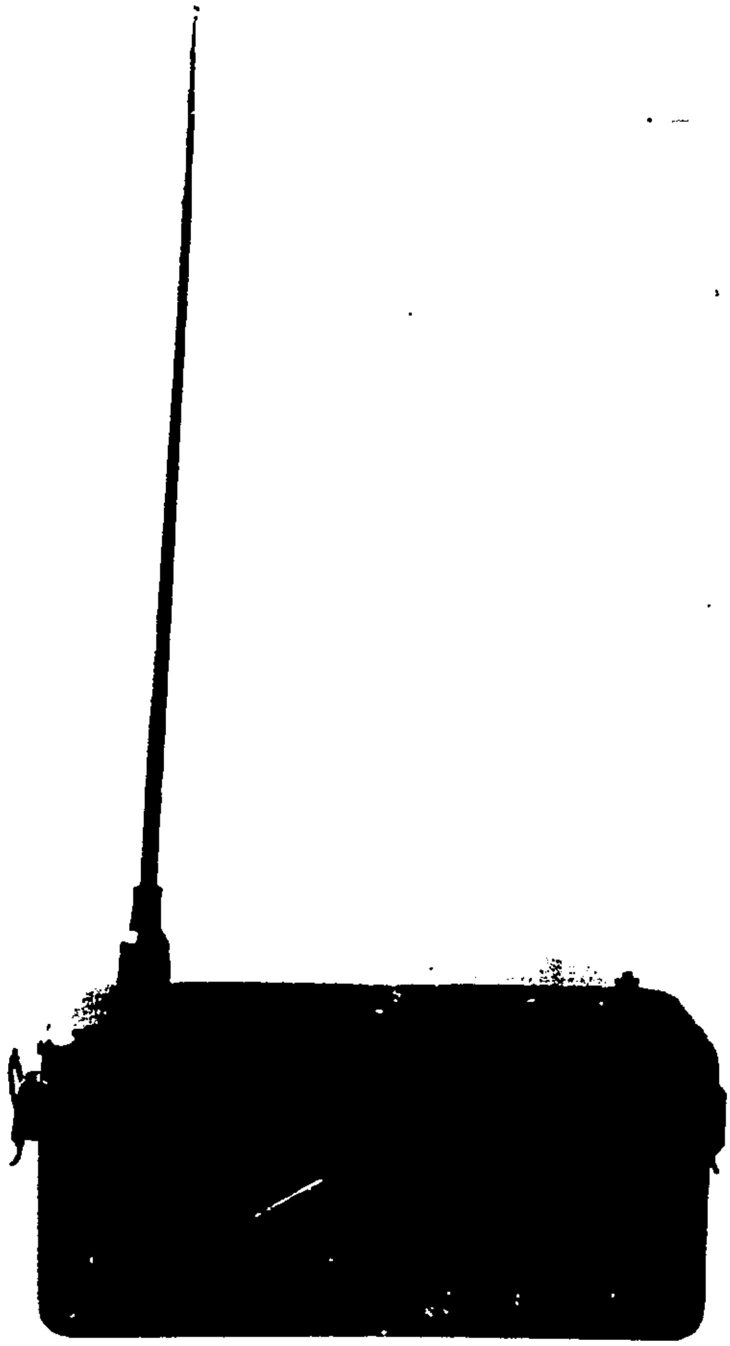
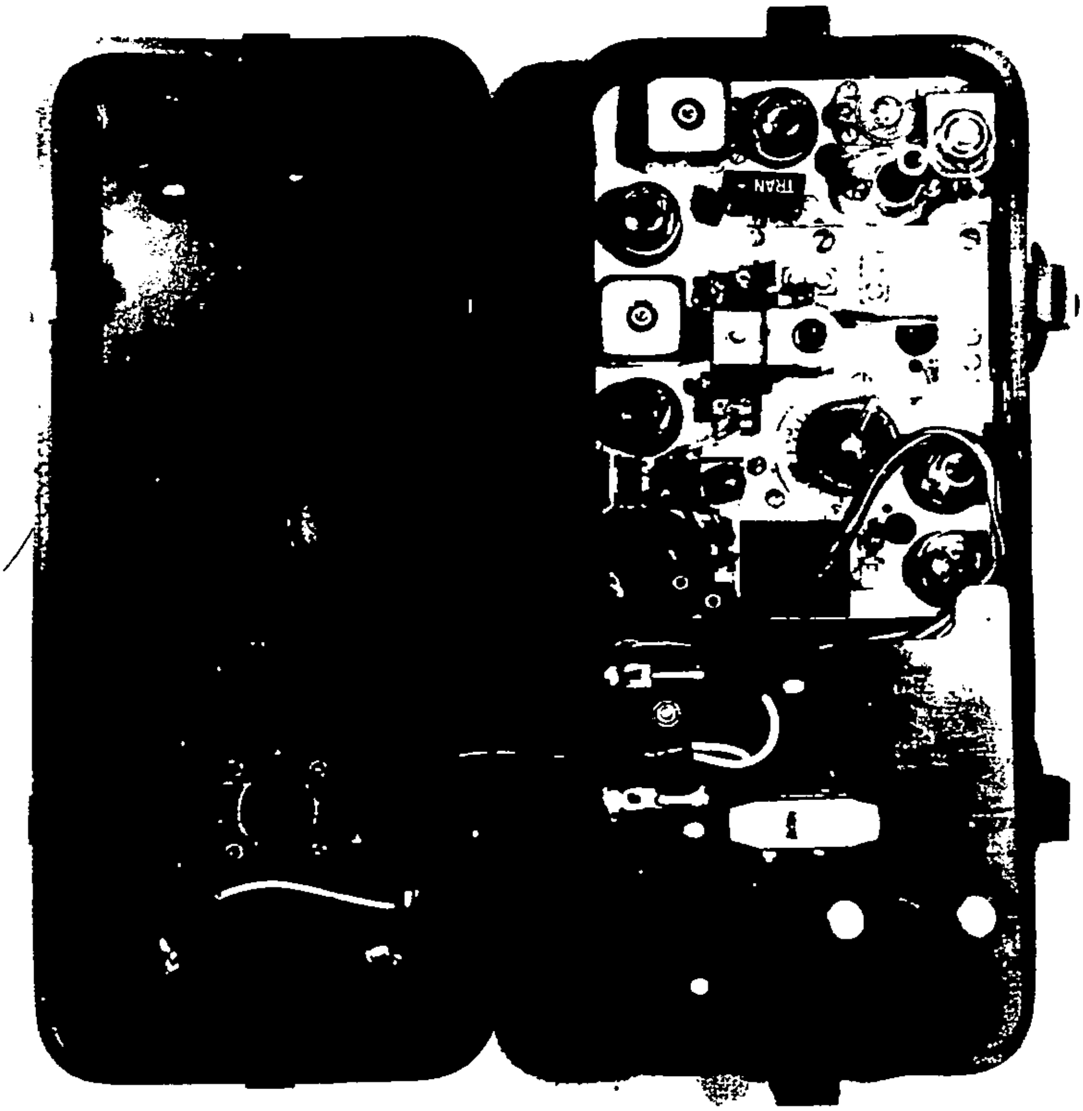




SAC-3 ABALONE

Part I: General

Operational Background

A very important type of coup de main operation carried out with great success by organized parties was the attack on merchant ships with underwater explosive charges known as Limpets. Since SAC-42 is a problem on the general subject of Limpetry, further details can be found there. It is sufficient to say here that part of the problem of Limpetry is concerned with the attachment of Limpets under water to the sides of the ships. This attachment is rendered difficult by the presence of scaling paint, rust, and slimy marine growth.

In operations it is customary for the Limpet charge to be placed by a swimmer equipped with underwater breathing apparatus or by a team of two individuals in a small boat. The latter method is more generally preferred. In either case, it is not an easy matter to secure the Limpet to the side of the vessel with a minimum of noise and in a matter of only a few seconds, with all the surrounding distractions of guards, wave slap, and currents. It was definitely desirable that some easy method be found to secure a Limpet with great speed under these adverse conditions.

General Statement of the Problem

The problem as originally posed concerned itself exclusively with attachment of Limpets by means of adhesives, but in the course of time several methods of attack on the problem became important. In addition to adhesives, work was performed with suction cups, magnets, and explosive nails. For clarity the various approaches to the problem are broken down below according to these different headings.

Part II: Adhesives

Historical Background

At the time when the problem was first discussed in the fall of 1942, magnets were the main method of attachment of Limpets, but it seemed that perhaps adhesives would offer certain advantages in saving weight and in eliminating the troublesome effects that magnets have upon compasses carried by the operators.

About the first of November, sixteen different manufacturers of adhesive materials were canvassed with the general problem, and most discouraging replies were received from all of them. It was the consensus of opinion that an adhesive material could be of a type which hardened with water or of a type which did not harden with water. If of the former, it appeared that to carry a Limpet coated with such material underwater would necessitate extreme care in protection of the adhesive up to the moment of application, and it was doubted that such application would be at all easy in actual operations. The other type of adhesive which would be unaffected by water was felt to be quite unsuitable, since it could not be expected to adhere to a fairly wet surface, inasmuch as a film of water would be everywhere interposed between the adhesive and the metal plates.

(b)(3) NatSecAct

In spite of the most unpromising nature of the suggested problem, the [redacted] Corporation was interested in it, and a research contract was initiated with them on November 1, 1942. Under the able direction of [redacted], various approaches were attempted, and a number of commercially obtainable materials were tried. In addition, attempts were made to redesign the Limpet so as to give it neutral buoyancy in water and thus to remove the greater part of the stress which would be imposed on the adhesive bond. Further suggestions included the use of a fabric base on the Limpet to incorporate the adhesive in a thick pile, the thought here being that such a surface would be forced into very intimate contact with the irregularities in a ship's plate and produce the closest bond.

(b)(3) CIAAct
(b)(6)

By January of 1943, sufficient work had been done with all of these ideas to show that it was entirely impractical. Adhesives were found which would adhere well to wet, clean, smooth surfaces under water, but absolutely no success was had with adhesives on rough, scaley, slimmy plates. The explanation for this lay in the fact that while the adhesive would adhere to the superficial surface, this in turn had no mechanical strength and pulled and scaled off from the base plate at once. Since the liaison officers decided that it was impossible to request an operator to prepare the plate to receive the adhesive by scraping, the problem became impossible to solve by this method, and the original purpose was therefore abandoned.

A meeting with Captain Sam G. Lucy of OSS in January of 1943, at which the various ideas thus far tried were demonstrated, concluded that while the original problem could not be solved a useful material might still be

obtained in connection with a slightly different problem, namely the application of Clams and explosive charges to a variety of surfaces. A standard item of equipment with the British was the so-called Clam, which consisted of a plastic case holding a charge of approximately 1/2 pound of plastic explosive to be fired by time delay Pencils and equipped with magnets for its quick attachment to iron and steel surfaces. This type of weapon has been used in all armies, especially for attack on vehicles and tanks and in the convenient size of the British was easily carried by saboteurs for placing on industrial targets.

In addition, it was a standard practice with the British to use for such operations previously prepared charges of plastic explosive wrapped in rubberoid fabric and linked with primacord. The attachment of charges of this type required some skill and time, and a variety of equipment such as adhesive tape, props, wires, etc. Moreover, it was obvious that the magnetic clam cannot be expected to attach itself to anything but iron targets. For these reasons, it seemed at that time desirable to develop an adhesive material which when spread on an explosive charge would allow its instant attachment to any surface, dry or wet.

(b)(3) NatSecAct

It developed at once that the Engineer Board at Fort Belvoir had a similar problem, and indeed had begun work on it; therefore from February 1943 to the end of the [redacted] contract an informal liaison existed between the Division and the Board, with Captain Walter Ford, Jr., [redacted] and [redacted] being the interested officers. The military characteristics desired of this adhesive included the following: sufficient strength to hold one pound on a vertical surface with 6 square inches contact for a period of one hour; storage stability for a period of 12 months; effective use over a range of temperature from 10° F. to 95° F.; and satisfactory functioning on rough, dry, wet, oily, and dirty surfaces.

(b)(3) CIAAct
(b)(6)

On March 23, 1943, [redacted] submitted the first sample of a material for this purpose, and it was concluded that while the material worked fairly well on certain dry surfaces it was of no use on moist surfaces. In June work had progressed to a point which seemed to indicate that ester gum (65 parts), plasticized with materials (35 parts) such as cottonseed oil or dibutyl phthalate and thickened by the addition of asbestos floats (80 parts) appeared to be the most promising line of attack. On July 2, a second sample of this type (RD-43-28) was submitted to the Engineer Board.

(b)(3) NatSecAct

Modifications of this formula continued throughout the year of 1943, and samples of some size were tested at MRL in August and October. Samples of these materials, RD-43-45 and RD-43-46, were taken to England by Dr. W. C. Lothrop and the testing there was encouraging. It was, however, recognized that in these tests the answer had not been found.

As a result, in December a still further modification of the formula (RD-43-141) was made available to Fort Belvoir and MRL for tests. Very successful trials were performed by the Engineer Board on December 30, 1943. In these trials under winter conditions, a variety of explosive

charges was attached to wooden, steel, cement targets, all soaked with oil and water and covered with dust. It was concluded that the adhesive appeared satisfactory on all dry targets where the dirt on the surface was not present in amounts so large as to prevent contact between the adhesive and the true surface. Less satisfactory results were obtained with wet concrete, and indeed this proved eventually to be the most difficult surface to attack.

As a result of these tests, on January 15, 1944, a letter was forwarded to NDRC, Division 19, from Colonel R. M. Osborne, War Department Liaison Officer for the NDRC, stating that "the material fulfills the military characteristics with the exception of being useable at sub-zero temperatures." The request was made that NDRC improve the low temperature characteristics.

During January and February, an additional adhesive was developed which functioned satisfactorily at temperatures between 10° and 70°, the thought being that this material (RD-44-10) would cover the low temperature range, while RD-43-141 would cover the high temperature range. At the same time, samples were supplied [redacted] The Engineers deemed it inadvisable to supply the field with two items, and attempts were continued to find an adhesive which would cover the whole temperature range. This was partially successful, although it still appeared that RD-43-141 had in general better qualities. On May 1, 1944, 50 pounds of both the above adhesives were supplied to Fort Benning at the request of Army Ground Forces for their trial.

(b)(3) NatSecAct

Soon thereafter it became evident from large-scale testing at Fort Belvoir that these materials still left something to be desired for adhesion to wet concrete. This prompted the discovery that the addition of Bentonite to the mixture gave superior performance on all types of wet surfaces. Bentonite has the property of taking up water in large amounts and swelling thereby. The presence of this material in the mixture meant that the water film existing between the adhesive and surface was taken up by the adhesive, with a consequent swelling of the surface into all the roughnesses and interstices, giving intimate and firm contact. Materials incorporating Bentonite were formulated as RD-44-40 and RD-44-41. Further samples of these were shipped to the Army Ground Forces, the Engineers, MRL, the British, and the Canadians. The material appeared to satisfy the OSS requirements, and on July 5, 1944, an order was placed by them for 500 pounds. On July 18, a report was received from the Corps of Engineers indicating that the material appeared to them to be the best thus far supplied.

It was during this month that tests were run at Fort Benning by the Infantry Board comparing RD-43-141, which did not contain Bentonite, with RD-44-41, which did. The Infantry Board report (No. 1674) summarizing these tests concluded that RD-43-141 was superior to RD-44-41 "in general utility, including durability and stability, and is desirable for Infantry use." It was recommended that the adhesive be included in Standard Demolition Kit No. 5. By way of compromise with the Engineers, who had felt the reverse, the Army Ground Forces eventually accepted RD-44-41, and procurement was started by the Engineer Corps.

During October 1944, at the request of the Engineer Board, the [redacted] (b)(3) NatSecAct Corporation prepared tentative specifications for the manufacture of RD-44-41, and continued work with the hope of meeting the recommendation made by the Infantry Board that an adhesive less sensitive to water be developed. In November 50 pounds of the resultant mix, RD-44-75, were sent to Fort Belvoir for testing, but it was concluded that while a slight improvement had been obtained it was not sufficient to alter the adoption of RD-44-41, and it was further concluded that there was no likelihood of bettering the formula.

This material was also successfully tested in England by the British, and on December 18 a report was received from them indicating its adoption for limited use in special operations.

The Engineers' requirement in the amount of 145,000 1/2-pound cans, deliveries to be made at the rate of 14,000 per month, reached the [redacted] (b)(3) NatSecAct at the end of March 1945.

(b)(3) NatSecAct

This work [redacted] resulted in a product which, while not entirely perfect, was better than any which had theretofore been developed and was vastly superior to German, British, and Canadian adhesives. By its use, it was possible to attach an explosive charge weighing up to 1 pound in the minimum time and with minimum difficulty and without regard to the surface condition. In operations it would be possible to apply the adhesive to the charge in the field or previously with the adhesive protected by an oiled paper, which could be stripped off at the moment of use. The adhesive layer, which in no case exceeded 1/4-inch, was found to have little effect on the results obtained from the explosion. The material, while somewhat sensitive to water, was not unstable in a sealed container and was entirely workable over the full temperature range originally requested. Thus a very difficult problem reached a satisfactory conclusion.

Technical Information

(b)(3) NatSecAct

Specifications for the final adhesive, RD-44-41, as well as its close competitor RD-43-141, may be found in the appendix of the final report of the [redacted] Corporation dated October 30, 1944. The material can be prepared in a kneader which is equipped for heating and cooling and preferably has Sigma-type blades. The following composition is recommended:

Raw Material — **Parts by Weight**

[redacted]

(b)(3) NatSecAct

(b)(3) NatSecAct

[redacted]

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Problem Submitted: October 21, 1942. **Problem Terminated:** November 7, 1944.

Contract: OEMsr-850 with [redacted] official investigator; November 1, 1942, to February 28, 1945.

Final Report: Division 19 Serial No. 20 submitted to [redacted] on December 6, 1944.

(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded [redacted] on April 7, 1945: "Plastic Adhesive" by Skow, Seiler, Oriani, and Whitaker.

(b)(3) CIAAct
(b)(6)

NOMENCLATURE: PASTE, ADHESIVE

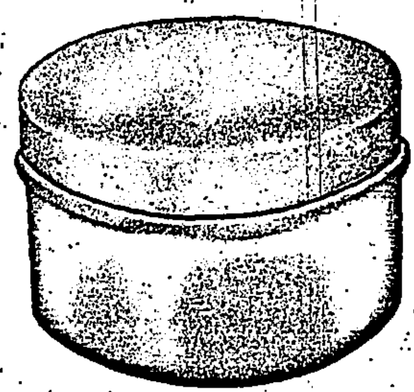
PURPOSE: To fasten an explosive charge to various types of surfaces.

SPECIAL FEATURES: Paste, Adhesive is capable of long storage and is effective over a range of temperatures varying from 20°F to 125°F. Paste, Adhesive can also be used as a temporary waterproofing agent to seal leaks in water cans and to waterproof radios and other equipment.

DATA:

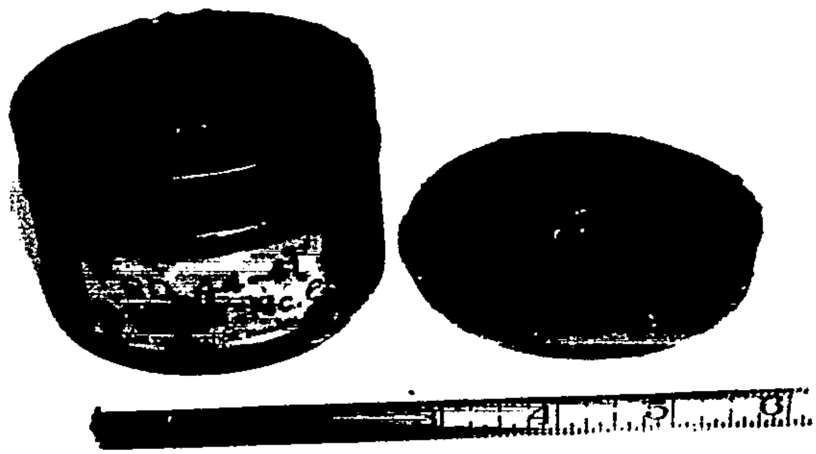
Dimensions of tin can container:

Diameter ——— 3 3/8 in.
Height ——— 2 3/8 in.
Weight ——— 1 lb.

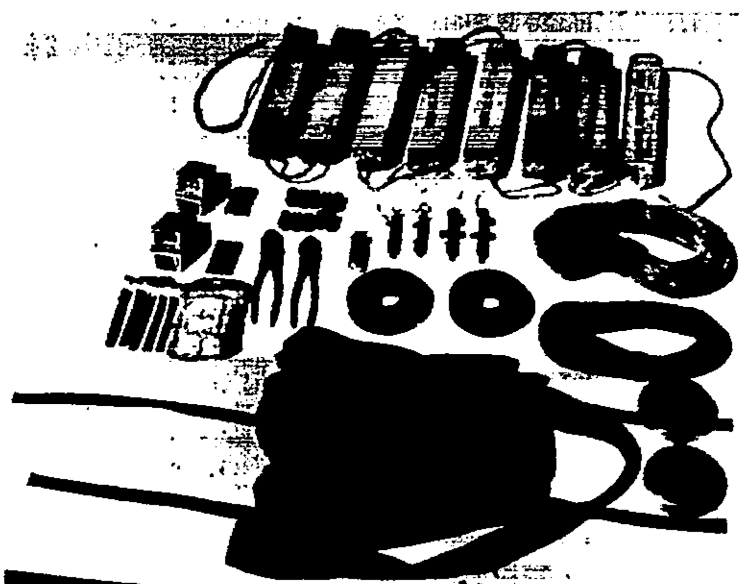


ISSUED BY: OSS,

ORDER AS: Paste, Adhesive



Adhesive RD-44-41. Note the viscosity.



4-41262-5

A Demolition Equipment Set No. 5 (individual) with contents. The cap protectors are not included. The flat containers filled with 1/2 lb. Adhesive "A" in each.

Approved for Release: 2018/06/04 C02393825

(b)(3)
NatSecAct

[redacted]

Part III: Suction Cup

Historical Development

Since rubber adhesives had not received any attention by the [redacted] (b)(3) NatSecAct [redacted] inquiry was made of several rubber companies with a view to determining whether they might have materials of promise in the original problem. In April 1943, as a result of contacts with the [redacted] (b)(3) NatSecAct [redacted], a contract was proposed to investigate this problem. The results were entirely comparable with those recorded above.

Rubber adhesives performed in the same way as all others which had been tried and were entirely impractical for use with Limpets. The suggestion was made, however, that perhaps rubber suction cups would provide an answer.

By September 1943 tests had proceeded with actual vessels at the Brooklyn Navy Yard and in Sandusky Bay, Ohio. This work had reached the stage where samples were available for Dr. Lothrop to take to England in September 1943, and while these did not work well, they did perhaps arouse interest, for in the succeeding year the British developed a suction cup "hold fast" which, while superior to anything along these lines known up to that time, still did not perform entirely satisfactorily.

On October 20, 1943, with the assistance of OSS, comparative tests of the suction cup device, the Explosive Nail, to be described, and adhesives were run on a Navy Minesweeper in New York Harbor. These resulted in a shift of interest to the Explosive Nail, and the conclusion that the suction cups were entirely inadequate on surfaces having deep rust pits or covered with marine growth.

As a means of overcoming this difficulty, it was thought that perhaps a combination of adhesive and suction where the adhesive was a coated layer on the inside of a cup might give improved performance. Work was therefore carried on during the winter with this idea, especially with the thought that such a cup might be useful in providing a lever mount for the Limpet placing rod, which is used when the Limpets are applied from boats.

On January 14, 1944, final tests of this idea were held at MRL in comparison again with the Explosive Nail. It was demonstrated beyond doubt that the suction cup, while occasionally satisfactory, was too unreliable to be considered further. Accordingly, the [redacted] contract was allowed to expire on March 1, 1944, with only negative results.

(b)(3) NatSecAct

Technical Information

Four basic designs of rubber suction cups were investigated. These varied in the depth of the cup and in the width and thickness of the lips. As originally received from the manufacturers, these cups "had only a very smooth surface of a cured rubber stock, and as a consequence would work only on smooth surfaces. To overcome this difficulty, a layer of red sealing gum was admitted to the surface of the rubber insert. This was of uncured stock and approximately 1/8-in. thickness." Thus, functioning with moderate success on rough surfaces was obtained but there was still failure on sea growth.

An alternative type of surface was then tried, namely "sheet sponge rubber 3/32 inch thickness of the unit seal type." Coating of this with butyl rubber of 0.015 in. thickness to close the holes gave a still more satisfactory surface, and this with a rubber-butyl "squeegee" was still more satisfactory. In conjunction with six or eight different types of rubber cements, this type cup gave the best performance and on clean dry surfaces was truly amazing, supporting several hundred pounds on a 3-in. cup, but again it failed on wet, rough, and dirty surfaces.

Problem Submitted: October 21, 1942. Problem Terminated: November 7, 1944.

Contract: OEMsr-1072 [redacted] (b)(3) CIAAct
[redacted] official investigator; June 1, 1943, to March 1, 1944. (b)(3) NatSecAct
(b)(6)

Final Report: Division 19 Serial No. 14 submitted [redacted] on June 4, 1944.
(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded [redacted] on June 29, 1944. No inventions were made.
(b)(3) CIAAct
(b)(6)

Part IV: Magnets

Historical Background

On March 20, 1943, a special request was received from OSS for improving the magnets currently being used by the British for Limpets and locating and developing a source of manufacture in this country. It was hoped that the magnetic properties might be enhanced either by developing a better magnetic alloy than Alcomax or by altering the whole design.

This was not an easy problem, since the British had reached a high state of development and had designed a Limpet with six standard magnets weighing approximately 1/2 pound each, each magnet supporting a weight of 15 pounds. This might seem excessive in view of the fact that Limpets under water could not be expected to weigh more than 10 pounds. Actually the margin of safety is not too great, because the supporting value of the magnets is not additive, so that six of them do not necessarily give a total support of 90 pounds. Secondly, there is very little resistance on the part of the magnets to a lateral motion, and in actual practice tests with ships at sea it was found that under the action of currents and wave slap magnets tended to slide along the vessel, frequently to drop off thereby or end at points where the Limpet was not effective. Lastly, as is well known, the force on separation between the faces of a magnet and a steel plate drops off exponentially, so that a very small gap greatly reduces the effectiveness of the magnet. Inasmuch as all ships have coatings of rust, marine growth, and paint, the gap between the face and the ship's plate may approach a critical point.

For all these reasons, it was desirable to perform further work, to improve magnets, and since British production was inadequate, to locate sources of supply in this country which would at least duplicate performance already being obtained.

(b)(3) NatSecAct

Certain informal relationships existed [redacted] and Major Lucy, representing OSS, and Commander Bird, representing SOE. These began in November 1942 as a result of inquiries addressed [redacted]

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct

It was not until March 20, 1943, that a specific formal request was received by Division 19. As a result of this, a contract was entered into with the [redacted]

(b)(3) NatSecAct
(b)(3) NatSecAct
(b)(3) NatSecAct

At the time when [redacted] was approached, Alnico II magnets were in use by SOE; these were later changed to Alnico V. Using these magnets supplied by OSS, [redacted] investigated various design changes and the effect of soldering soft iron pole faces to concentrate the flux. Some gain was obtained by this change, the turgidity being increased two to three times with these new faces; however, the effectiveness was greatly reduced by the introduction of small gaps, and it was ultimately concluded

that the soft iron pole faces were not a benefit.

Alcomax magnets, submitted during the course of the work by the British, were felt to be somewhat inferior to their previously used Alnico V. An American attempt to duplicate Alnico V with a somewhat different composition was shown to be entirely equivalent. Certain difficulties encountered in manufacture due to flaws and a tendency to brittleness were successfully overcome through advice to the manufacturers.

Following this, OSS placed an order with [redacted] (b)(3) NatSecAct and magnets the equivalent of those produced in England were soon in American production. The information obtained under the contract was therefore put into immediate practical use and resulted in a satisfactory magnet for use both in American Limpets and American Hold-Fast, the latter being a device to provide a grip for Limpetry operators working either from boats or swimming.

Technical Information

The recommended composition of Alnico V is given as follows: 8.42% aluminum; 14.73% nickel; 22.40% cobalt; 3.12% copper; 0.06% carbon; 0.09% manganese; and 0.21% silicon.* Magnets made of this material followed by heat treatment give stable flux values of 35,650 lines on the first break. This compares with 34,200 lines for the British Alcomax magnets. For optimum strength in a magnet of the contour required, it was found necessary to shape the field to the magnet. Data were collected which showed that with no gap and with the same design Alnico V requires a pull of 51 lbs. for separation compared with a value of 40 lbs. given by Alcomax. As the gap is increased, the value of both magnets drops rapidly, so that with a gap of 125 mils they are 10 and 7.5 lbs. respectively. In every case, however, the effectiveness of Alnico V seems slightly greater than Alcomax. Both materials are, however, so far superior to the originally used Alnico II that it is possible to drop the number of magnets required to support a Limpet from 8 to 6, thus saving about 1 pound in useful weight.

Formally Submitted: March 20, 1943. Problem Terminated: September 2, 1943.
(b)(3) CIAAct

Contract: OEMsr-1012 [redacted] (b)(3) NatSecAct
official investigator; November 10, 1942, to August 31, 1943. (b)(6)

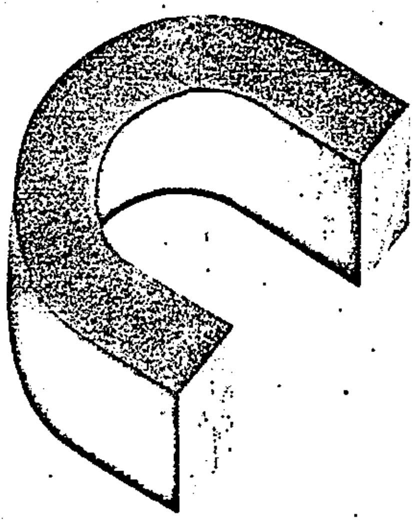
Final Report: Division 19 Serial No. 4 submitted to [redacted] on November 29, 1943. (b)(3) CIAAct (b)(6)

Patent Report: Forwarded [redacted] on December 7, 1943. No inventions were made.
(b)(3) CIAAct
(b)(6)

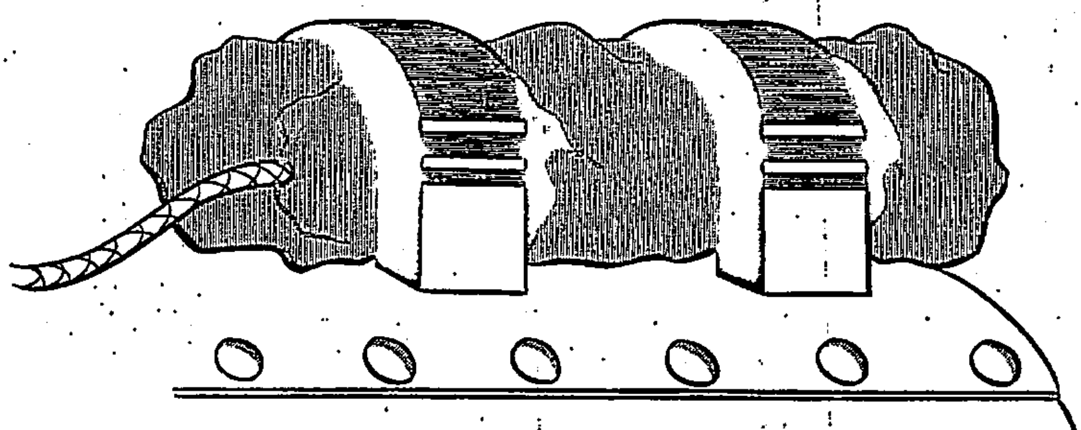
*The remainder is of course iron.

NOMENCLATURE: MAGNETS

PURPOSE: For attaching improvised charges to iron or steel surfaces.



USE: Magnets may be used singly or in numbers. They are particularly useful for placing large charges or for readily applying charges when speed is an important factor.



DATA:

Size	2¼ x 2 x 1 in.
Packed	100 to a case
Shipping weight of case	55 lbs.
Cubage	5 cu. ft.

ISSUED BY: OSS

ORDER AS: Magnets

Part V: Explosive Nail

Historical Background

This device, otherwise known as the "Snail" or "Pin-UP," was not strictly speaking a Division 19 development. It did, however, originate in suggestions made by NDRC contractors.

When the Limpet attachment problem was first presented to the [redacted] (b)(3) NatSecAct Corporation, they suggested that perhaps a device could be made which would in essence nail the Limpet to the ship. At the time it was considered impractical to consider this further because of the attendant noise; however, in August 1943 [redacted] another contractor of the Division, suggested that devices in production by the [redacted] Company might be adaptable to the purpose. The Research and Development Branch of OSS pursued this idea by direct contacts with [redacted] and the function of Division 19 was to assist through providing facilities and testing programs at MRL.

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct
(b)(3) NatSecAct
(b)(3) NatSecAct

As has been mentioned above under the description of the Suction cup, the Pin-Up seemed as early as October of 1943 to be the most promising method for Limpet attachment. When actually tried on a Navy vessel, the accompanying noise was found to be so small as to be quite non-suspicious. The problem from that point on was largely one of developing the Pin-Up in two forms, one for wooden ships and one for steel, and to make it reliable in operation and safe to use.

In January of 1944 semi-production quantities were ordered by OSS, and these were later tested at MRL with the result that further production was greatly benefited. MRL also undertook experiments calculated to indicate whether the explosion connected with the discharge of the Pin-Up would endanger the ears of a swimmer. It was concluded from this work that with properly constructed Pin-Ups the danger was small, especially if the swimmers were provided with ear plugs. By the beginning of 1945 the device had been entirely proved and was in active procurement.

It may be worth noting for the record that in August and September 1943 the [redacted] company produced a breadboard model of a job driven by a spring, which of course was quite ineffective on steel plates but was powerful enough to penetrate water-soaked oak to a depth of one inch, thus indicating a possible silent method of attachment to wooden vessels. This idea was not pursued further, however, in view of the promise with Pin-Up and the production of a model specially designed for wood.

(b)(3) CIAAct
(b)(6)

Technical Information

[redacted]

(b)(3) NatSecAct

Problem Submitted: October 21, 1942. Problem Terminated: November 7, 1944.

Contract: None.

(b)(3) NatSecAct

(b)(3) NatSecAct

SAC-4 LOST CHORD

Part I: General

Operational Background

Prior to full scale Allied offensive action against occupied Europe and later against Japanese held territory, both OSS and SOE and similar organizations in the regular Armed Services made frequent raids upon the enemy coast. The object was to play on the enemy's nerves, gain information, carry out minor attacks on special targets, and capture hostages. These commando-type operations were generally on a very small scale, frequently involving only a few men, and it was of great importance for morale that every effort should be made to bring these men back from their hazardous missions. Almost invariably they were landed in the first place from ships which approached close to shore at night, and a rendezvous was established a few nights later when the ship would return to pick them up. This was not easy to accomplish and many men were lost. The problem therefore existed of supplying these men with simple homing and communicating devices suitable for ship to shore, shore to ship, and ship to ship use. A further similar problem existed of giving these commando troops simple equipment with which they could communicate over short distances with each other with the highest security. Devices suitable for this use would at the same time answer the difficult problem of recognition.

All of the above aspects were gathered together and submitted to the Director's Subcommittee for attack, and in addition, a related but distinctly different requirement was added, namely the development of a device allowing the quick location of bundles dropped by aircraft. This became known as the Parachute or Cannister Locator problem and existed because of the large-scale OSS and SOE supply missions, which during the period before D-Day dropped many thousands of tons of supplies to the Underground throughout Europe. During the course of the war the Underground became so highly organized and the German defense so weak that regular schedules of supply were maintained with Halifax and Liberator bombers dropping at a prearranged spot the stores which that particular Underground cell required. Although the plans was met by a so-called reception committee which gave the proper signals from the ground, and although the pilots of these bombers were highly trained to fly at altitudes less than 1500 feet and at stalling speeds, a wide distribution of bundles inevitably resulted. The location of these at night in undergrowth and rocky country was not easy for the reception committee and was further complicated by the ever present threat of German interference.

The Underground, therefore, frequently asked for a simple device which would lead them to the dropped containers, while at the same time not disclosing their position to anyone else. It was found both in Britain and in America that these requirements were too severe; nevertheless, the problem was solved in part.

General Statement of the Problem

As originally presented, the problem was not too specifically defined. A series of meetings of the interested parties took place from which it became clearer what the exact requirements were and the relative priority which the operating groups assigned.

When a contract proposal was presented on behalf of the Director's Subcommittee by Section 17.3 in February 1943, it appeared that the problem could be divided into the following five parts, arranged in order of priority:

1. Emission of a suitable secret signal from a load dropped by parachute to expedite location of the load.
2. Secret signaling from a person on a beach to a ship.
3. Secret signaling from ship to ship.
4. Signaling for communication and identification in commando operations.
5. Signaling for identification by secret agents not known to each other.

Historical Background

On February 2, 1943, [redacted] called a meeting in New York attended by representatives of [redacted] The latter two attended because of their familiarity with NDRC work along such lines.

Following the definition of the problem as given above, a contract covered by a transfer of funds from the Director's Subcommittee to Division 17 was initiated with the [redacted] This [redacted] in effect until the end of Division 19 on June 30, 1945, and [redacted] group was given a free hand in the investigation of all types of secure short-range communication devices.

In the discussion below no attempt will be made to cover every avenue followed by this group. Instead, the more significant contributions will be taken up individually.

Part II: Canister Locator

Historical Background

At the start of NDRC work, this problem was primarily a British one and had first been called to NDRC's attention by a letter of September 1942 sent by Professor D. M. Newitt, Director of ISRB research, to [redacted] at that time in the London OSRD Liaison Office. Professor Newitt, in March 1943, sent over a further analysis of the requirement and recounted the many approaches which had already been made by the British research group. Among these were lights, smoke, fluorescent and phosphorescent paints, bells, and even odors. In general none of these investigations had been fruitful, either because of the susceptibility of the range of the device to the terrain or because of the lack of security provided the reception committee.

After a careful weighing of the pros and cons of all the physical phenomena on which such a device could be based, [redacted] selected as most promising a penetrating, intermittent whistle operated by compressed gas and functioning at the frequency of 3000 cycles, selected because the human ear is extremely susceptible to this frequency.

In its simplest form the Canister Locator consisted of such a whistle, a high-pressure gas cylinder, a low-pressure automatic gas chamber, suitable valves, and a triggering device which started operation when the canister left the plane. The original SOE requirement imposed a disc-like shape on the device, since British dropping was conducted in prefabricated metal canisters approximately 6 to 8 feet long and 14 inches in diameter, and the locator was to be accommodated in one end under the folded parachute. In American dropping the custom was to wrap stores in tarpaulins and not to use rigid containers, thus requiring no special shape for the gadget.

While the original problem had come from SOE, Dr. King felt that the [redacted] solution to it would be of interest to the Airborne Command, and accordingly, on May 24, 1943, a breadboard model was supplied for test by that group at Camp McKall, North Carolina. The initial reaction was favorable, and a formal request for 25 pre-production samples was received in June. With the assistance of the Engineering and Transition Office two suppliers were located and parallel semi-production took place.

A purchase order was issued to the [redacted] for 30 units, and at the same time the [redacted] designed for production a somewhat different model without contract. The first of the [redacted] production was ready in September, when satisfactory trials took place at MRL. Five samples were immediately dispatched to England, and during October SOE conducted elaborate user trials in which the American whistle type was compared to the British electric bell and light types. The conclusion from these trials was that the whistle gave greater range and easier location and was less affected by unfavorable terrain. It was, nevertheless, unacceptable to the British user groups, who felt it did not provide sufficient security.

On November 16, 1943, the 25 units requested by the Airborne Command underwent a full-scale test at Camp McKall, and the report of this issued in December (Project 136) was negative, the feeling being that the device "did not show sufficient superiority" over the available equipment (lights) to warrant standardization. This decision was undoubtedly influenced by the unfortunately high price which the [redacted] (b)(3) NatSecAct charged for its work. Whether this price was reasonable in view of the complexity of the device and whether it was a worthwhile expenditure in any case were questions of continued debate for months. There can be no doubt, however, that the price did seriously and adversely affect the Services's decision.

The undamaged Locators remaining after the McKall test were reconditioned and divided by SOE and OSS for shipment to the field and used in actual operations. By this means it was hoped to clarify a user demand, but as so frequently occurred, they were never heard from again.

Nevertheless, early in February 1944 OSS decided to procure 100 Locators of the [redacted] type, and a contract was accepted by the [redacted] (b)(3) NatSecAct whose products received MRL trials and were not pronounced satisfactory until June 1945. MRL, also at a specific OSS request, constructed a number of models of the bell-light type Locator and reported on these in May 1945.

The rather unsuccessful outcome of this problem can be laid in part to the lack of imagination of the using Service and their inability to compromise their demand to an obtainable device. It must be said also that the device as designed and produced by NDRC, while it successfully performed its function, was complicated and expensive.

Technical Information ([redacted] Model) (b)(3) NatSecAct

At the instant of dropping, the locator is put into operation by the pulling of a starting cord. About 20 seconds later, presumably when the canister has reached the ground, the whistle begins to emit sharp blasts of 1-second duration followed by a silent interval of 3 seconds. This cycle is repeated until the reduced gas pressure becomes insufficient to operate the whistle. This occurs approximately 20 minutes after the initial blast.

"Under adverse conditions this signal is audible over a range of at least 200 yards, and under favorable conditions up to 700 yards. The whistle is very like those used on boats; air is ejected from an annular orifice toward a resonant cylinder placed a short distance" away. By a system of valves and the use of a low pressure tank the whistle is operated by a supply of compressed nitrogen stored at 1800 pounds per square inch in a volume of 30.5 cubic inches. In operation this high pressure gas flows through a controller valve into the low pressure tank until the pressure in this reaches approximately 100 pounds per square inch, at which time a diaphragm is opened and the low pressure tank discharges through the whistle until the pressure has dropped to approximately 80 pounds, when the

diaphragm closes and the cycle repeats. An operator can instantly stop the whistle by removing a handy rubber tube which leads the gas into the whistle.

(b)(3) NatSecAct

The [redacted] Model is 12-1/2x5-3/4x3-1/2 inches and weighs approximately 10 pounds.

Mine Safety Appliance Model.

This alternative design differs in the following respects. The high pressure tank containing nitrogen is in the shape of a doughnut, having a volume of approximately 100 cu. in. and containing case stored at a maximum pressure of 500 lb/sq.in. The initiating unit is separated from the pressure regulator, an arrangement which allows a relatively simple regulator design and permits the device to be manually shut off when locked. By use of a separate flow regulating valve, greater time delays may be obtained with this design and as a result the pulsing and time delay functions are easily and independently controlled.

(b)(3) NatSecAct

The over-all shape of the [redacted] unit is circular of a size determined by the doughnut shaped pressure tank. The auxiliary units are mounted in the interior section with the whistle projected from the center of the plate supporting these units. The pressure tank is used therefore to give required strength to the apparatus and due to the design the over-all device is relatively light. In basic principle the design is identical with the [redacted] Model and a choice between them would depend largely on the consideration of manufacturing difficulties.

(b)(3) NatSecAct

Problem Submitted: October 21, 1942. Problem Terminated: May 19, 1944.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

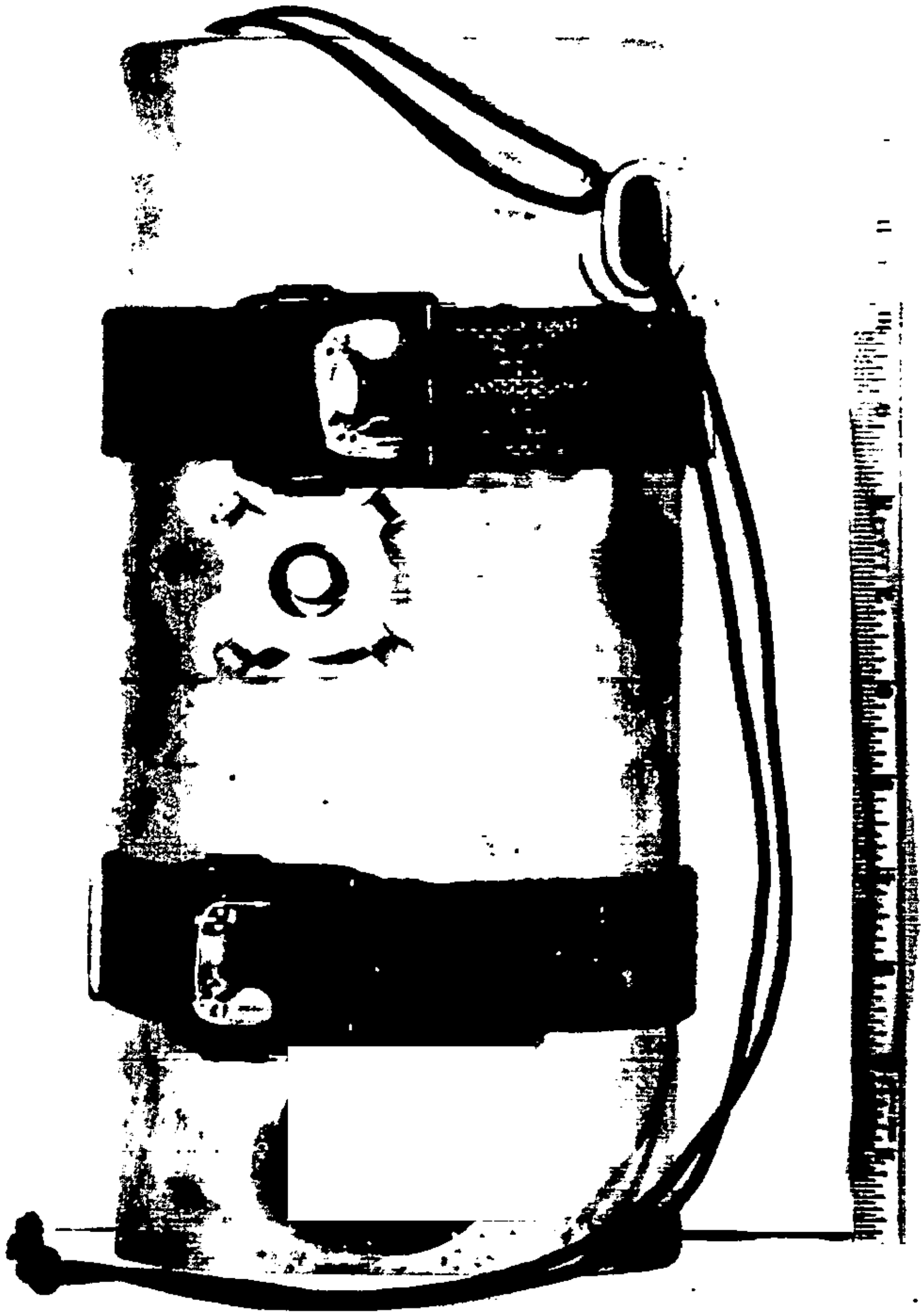
Contract: OEMsr-922 with [redacted] [redacted] official investigator; February 19, 1943, to June 30, 1945.

Final Report: Division 19 Serial No. 12, Part I, "An Audible Device for Locating Canisters Dropped from Planes," submitted to [redacted] on June 12, 1944.

(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded to [redacted] on October 11, 1945.

(b)(3) CIAAct
(b)(6)



(b)(3) NatSecAct

Part III: Induction Field Transceiver (IFT)

Historical Background

As stated in the introduction, a need was expressed for a device allowing short-range secure communication and recognition. [redacted] in June (b)(3) CIAAct (b)(6) 1943, demonstrated such a device based on an induction field (IFT - receiver and transmitter) and operating at a frequency of 50 kilocycles. This band of the spectrum was selected because it had been very little explored and therefore little used, and also because signals at this frequency are very rapidly attenuated at distances of 100 yards.

(b)(3) CIAAct (b)(6)

[redacted] work became known to the Navy, and in July the Coordinator's Office had correspondence with [redacted] Chief of Section 17.3, regarding a Marine requirement of a similar nature. The Marines, in common with most other operating groups, hoped for a supersonic device, but this had been considered by [redacted] and Section 17.3 to be impractical. It was agreed that the Navy would have an independent contract [redacted] (b)(3) NatSecAct for the construction of four sets of the supersonic type, while Division 19 would provide six models of the IFT for Marine appraisal.

(b)(3) CIAAct (b)(6)
(b)(3) CIAAct (b)(6)
(b)(3) CIAAct (b)(6)
(b)(3) NatSecAct

To fill this requirement and to supply ten samples to OSS and two to SOE, [redacted] instituted semi-production of fifteen units with the firm of [redacted] These sets were duly distributed to the interested Services, all of whom independently tested them and reached the identical conclusion that they had no requirement.

The Marine Corps Equipment Board, in a report of July 19, 1944, on Project No. 246, found "on the whole very satisfactory performance. The IFT was shown to be directional, to have a maximum range of 75 yards, a 12-hour operational life, and to be unaffected by buildings, trees, etc. The unit had a total weight of 2-3/4 pounds including the loop antenna to be worn around the user's waist. The IFT was both a code transmitter and a receiver with reception depending upon a bone microphone."

Again it appeared that the Services were not sufficiently imaginative to use a novel and valuable piece of equipment. This was the situation when on October 2, 1944, the problem was revived by a request [redacted] (b)(3) NatSecAct [redacted] for three Underwater Transceivers and six IFT's. The following months were consumed in arranging for production of these sets and their demonstration in the theater by a representative [redacted] [redacted] who traveled under Office of Field Service auspices. His report of March 13, 1945, indicated field reaction identical with previous Service reaction.

(b)(3) CIAAct (b)(3) NatSecAct (b)(6)

This sad story would have ended here had it not been for the energy, imagination, and interest of [redacted] NDRC Technical Aide stationed in London and scientific adviser to the Airborne Armies. He

(b)(3) CIAAct (b)(6)

secured samples of the IFT and IFL (Induction Field Locator, identical with IFT except that it transmits only) and demonstrated them late in February 1945 to Major General J. M. Gavin of the 82nd Airborne Division. General Gavin's staff received the new equipment enthusiastically, finding that it filled a need of theirs in providing secure methods of assembling a stick of parachutists and their equipment.

(b)(3) CIAAct
(b)(6)

Field trials in ETO resulted in March in a request from [redacted] for OSRD production of 36 IFT's and 4 IFL's. This was begun at once with the firm of [redacted] appraised both devices and made suggestions which were incorporated in the new semi-production models.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

While this was being pushed forward the First Allied Airborne Army formally requested through the New Developments Division the manufacture by the Signal Corps of 800 IFT's and 200 IFL's. Although further field requests in June for 2000 additional units were denied by the War Department because of the collapse of Germany, Signal Corps production of the approved 1000 units continued temporarily and was increased in May by 50 units at the request of SWPA.

In July the OSRD semi-production was completed and shipped to [redacted] for trial by General Gavin's group in Berlin. Throughout these summer months Airborne experience indicated a number of desirable modifications; and since the Pennsylvania contract had terminated, arrangements were made with Division 13 so that they could handle any further research work requested by the Army.

(b)(3) CIAAct
(b)(6)

The origin of the Induction Field Locator (IFL) requires brief notice. As early as June 1943, when the IFT first emerged, the need was recognized for a unit automatic in operation and acting as a transmitting station on which men equipped with IFT's could home.

It was not until April 1944 that active work was undertaken. It was done then at the request [redacted] who felt it desirable to have such a unit located in an agent's house so that another agent although a stranger to the locality could identify this house. Needless to say, this proposed operation never took place, but as so frequently happens, the device turned out to have unforeseen worthwhile applications in the hands of another user, the Airborne troops.

(b)(3) CIAAct
(b)(6)

The IFL located in a package of supplies can serve as a beacon on which the stick of men can organize themselves. This is possible because of the continuous intermittent operation of the IFL and the directional feature of the IFT which informs its user whether he is approaching or leaving the signal source.

Technical Information

The two devices are: (1) the IFT, for 2-way communication at distances up to 125 yds., and (2) the IFL, which continuously transmits a signal that can be received at a distance of 100 yds. by means of an IFT. Both devices operate on induction field signals and, as modified for Airborne Command use, work on frequencies of 40, 50, or 60 kc/sec. at the discretion of the user. "An audible frequency of about 25 cycles per sec. is produced in the receiver by heterodyning the received signal and a signal from a local oscillator."

The IFT is provided with a key for sending code signals. The combination volume control and an off-on switch are contained in an aluminum case measuring 7x4-1/2x1-5/16 ins. which can be worn on the belt of the user. The second part of the IFT is a coil antenna which generates the induction field when the user's apparatus is switched on and the key is pressed. The coil also acts as a pick-up device for reception when the key is released. This coil, measuring 17-1/2x11-3/4x3/16 ins., is worn on the user's back or around his waist. The third item of the IFT is an earphone supported by means of a headband which is convenient for use within a helmet.

The IFL consists of a box measuring 6-1/2x5x1-5/8 ins. having an on-off switch and a coil for producing an induction field at the desired frequency wound within the edge of the case. The remaining space is occupied by batteries and components of the oscillator circuit. The IFL weighs 2-1/2 lbs. and operates continuously for approximately 16 hrs.

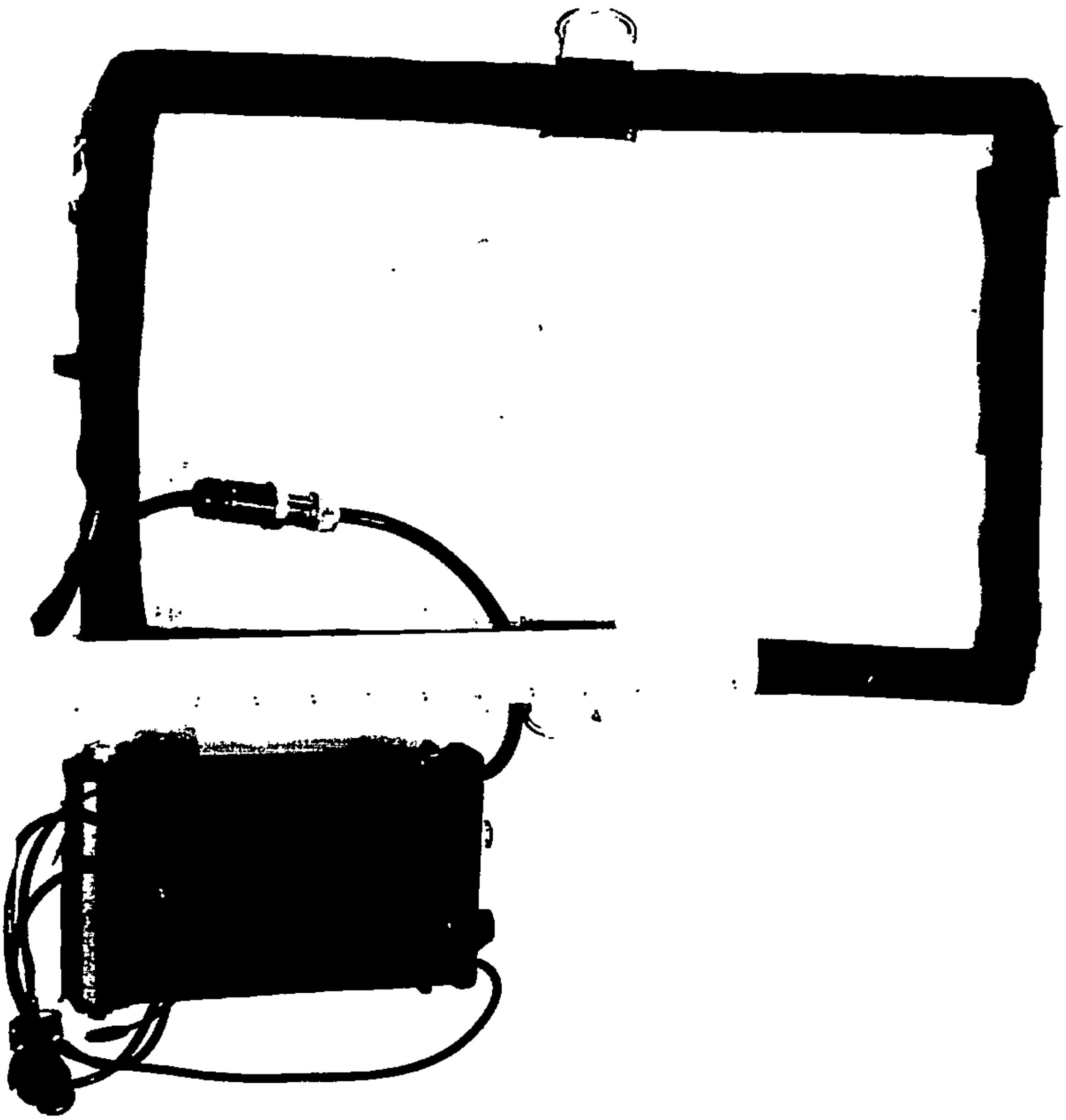
The signal from the IFL or from another IFT can be picked up by means of the receiving system of the IFT. "Maximum range is obtained when the planes of the coil of the IFT and IFL are parallel to each other and perpendicular to the line from the IFL to the IFT. The field strength of signals decreases inversely as the cube of the distance, although there is a relatively sharp null when the receiving and transmitting coils of two of these devices are perpendicular to each other. Homing is most effectively carried out by walking in a straight line and noting the rapid increase or decrease in signal strength."

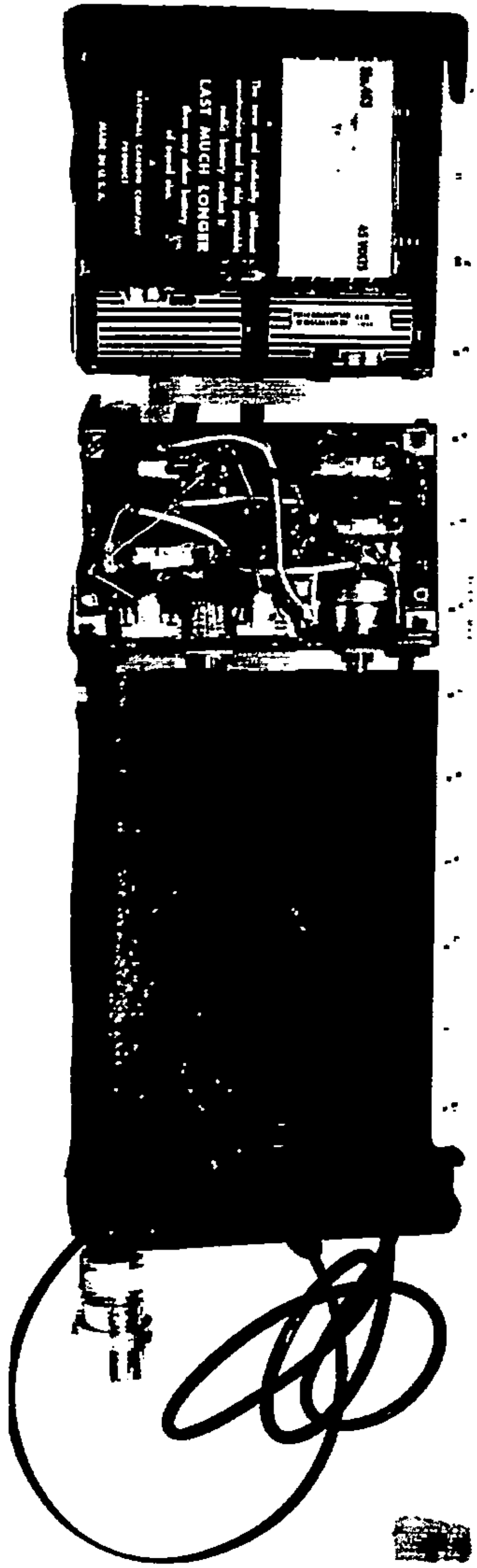
Problem Submitted: October 21, 1942. Problem Terminated: June 30, 1945.

Contract: OEMsr-922 [redacted] (b)(3) CIAAct
[redacted] official investigator; February 19, 1943, to June 30, 194(b)(3) NatSecAct
(b)(6)

Final Report: Division 19 Serial No. 12, Part II, "Short Range Induction Field Communicating System," dated June 30, 1945, forwarded to [redacted] (b)(3) CIAAct (b)(6) on October 2, 1945.

Patent Report: Forwarded to [redacted] on October 11, 1945.
(b)(3) CIAAct
(b)(6)




LAST MUCH LONGER

 Classification: Confidential

Part IV: Microwave Transceiver (MWT, Cluck)

Historical Background

(b)(3) CIAAct
(b)(6)

In August 1944 the existence of a special small Klystron-type tube operating on a wave length of 2.5 centimeters came to the attention of [redacted] group. It seemed to them that this offered the possibility of devising two-way communication by radiotelephone or code signal over line-of-sight ranges of up to one mile. It might thus solve the ship-to-ship and ship-to-shore problems.

(b)(3) CIAAct
(b)(6)

Although the wave length on which this tube operated was not available except by special assignment. the group developed an apparatus based on the tube, and at the request of [redacted] of OSS, constructed models of both the transmitter and receiver for hand and tripod use. These were tested by OSS with excellent results in the spring of 1945. Unfortunately, they were never produced or used due to the lateness of their arrival.

Technical Information

For voice transmission the essential characteristics of the MWT are as follows: distance, 0.5 miles; life, 6 hrs.; case size, 12x7x6 ins.; weight, 17 lbs.; power output, 10 m.w. The accompanying receiver weighs 3-1/2 lbs., measures 8x4x1-1/2 ins., has a life of 12 hrs., and is provided with a 6-in. parabolic mirror to receive and focus the signals.

The type of radiation is limited to optical reception, and the tube on which the work was done gives a frequency of 9400 megacycles. Although this lies within a restricted band, it is felt that minor alterations could place the frequency wave outside this band. The transmission is facilitated by the use of a horn, since the beam is highly directional, and the signal is received by a crystal detector coupled with a two-stage audio amplifier with a voltage gain of about 8000.

It is felt that this system has not been fully explored and that a potentially valuable device has been suggested.

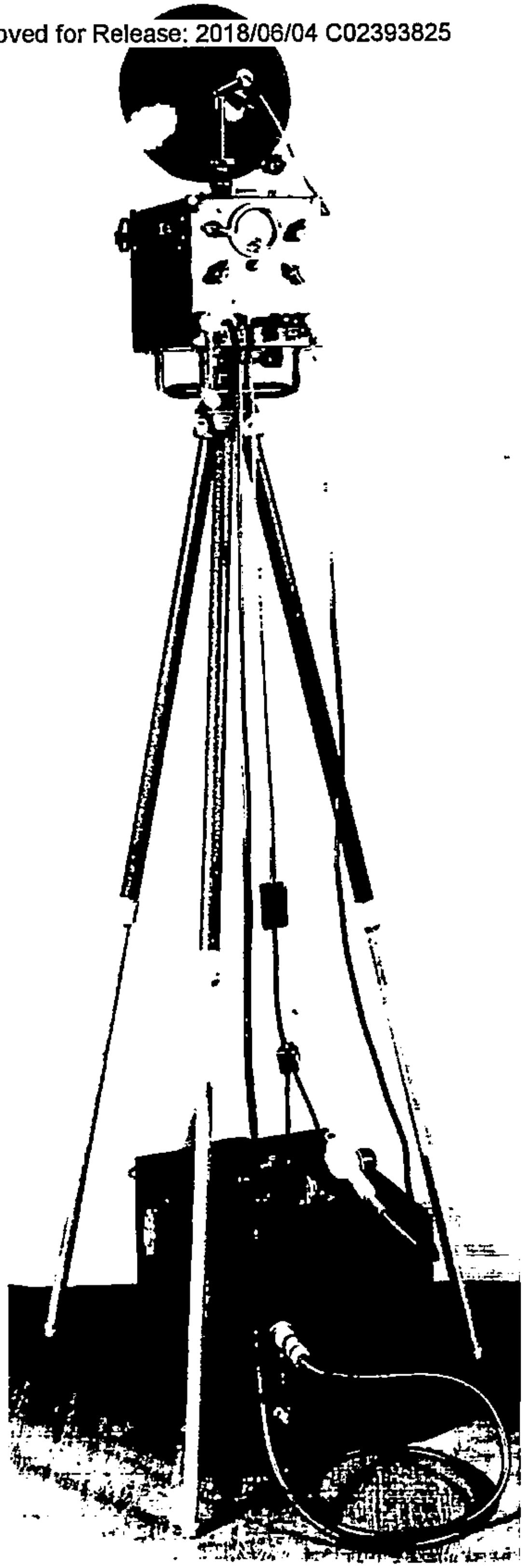
Problem Submitted: October 21, 1942. **Problem Terminated:** June 30, 1945.

Contract: OEMsr-922 [redacted] (b)(3) NatSecAct

Final Report: Division 19 Serial No. 12, Part IV, "A Microwave Transmitter-Receiver or Relay Station for Radiotelephone and Radiotelegraph Use." dated June 1945, forwarded [redacted] on October 2, 1945. (b)(3) CIAAct (b)(6)

Patent Report: Forwarded to [redacted] on October 11, 1945.

(b)(3) CIAAct
(b)(6)



Part V: Underwater Transceiver (UWT)

Historical Background

As part of the original problem, communication between shore and ship and homing on the ship by an operator in a boat or swimming had been vaguely defined. It was not, however, until April 1944 that any success attended the experimentation.

By that time a number of underwater devices depending upon the transmission of sound had been tested. These included vibrating membranes (hooter), the ammonia jet (a development of the Naval Research Laboratory), and the Klaxon (an old fashioned automobile horn). Tests of all of these in Chesapeake Bay indicated that it was possible to send underwater signals for distances up to several miles. None of the devices, however, gave much promise in the solution of the homing problem, and most of them were susceptible to the nature of the sea bottom, the depth of water, and the ambient noise level due to surf and fish.

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct

With the reopening of the problem in April 1944, an arrangement was made for [redacted] to learn of the transducer, a development of Section 16.1 and the [redacted]. This was a beamed ultrasonic device operating on 3000 cycles when supplied with 1500 cycle energy. It was found that while these crystal and magnetostrictive transducers operated to satisfy Division 6 requirements, they were not suited for Division 19's problem.

(b)(3) NatSecAct

Accordingly, the attention of the [redacted] group was turned to electric methods of underwater communication, and by September 1944 tests of an audio-acoustic dipole appeared quite promising in giving telegraphic communication, of great security over distances of at least one mile. It appeared likely that the system could be used in the homing problem as well.

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This development arrived at the psychological moment, for in November 1944 [redacted] SOE brought to the United States from England several Sleeping Beauties and the crews to operate them and put on a demonstration for the Navy and OSS. The Sleeping Beauty is a one-man craft operable on the surface or at depths down to 50 feet. Propulsion is by electric means and the operator is provided with a rubber diving suit and an oxygen mask. In operations the Sleeping Beauties were used to attack enemy shipping by means of limpets and similar charges, and they allowed the penetration of anti-submarine and torpedo nets.

In operations several Sleeping Beauties worked as a team, and signaling and communication between them was of highest importance. It appeared at once that the UWT had promise for this application, and on January 24, 1945, preliminary tests took place at St. Petersburg, Florida. These were entirely successful, and the Maritime Unit of OSS requested the installation of UWT's in two Sleeping Beauties. This was accomplished, and in May 1945 further

tests took place at Fort Lauderdale, Florida, where it was demonstrated that using a bone microphone and electrodes mounted on the bow and on a whip antenna extending 20 feet from the stern good results, both for communication and homing, were obtained up to distances of 250 yards.

At the time when the Pennsylvania contract was terminating, OSS and SOE had plans to install this equipment on their undersea craft, but due to the lateness in the war these never materialized.

It should be noted that [redacted] took to the Pacific and demonstrated (b)(3) CIAAct to the Sixth Army Headquarters two UWT's of the telephonic type used in (b)(6) the Sleeping Beauty and three UWT's of the code type. While this equipment functioned as expected, the Pacific Theater found it unsuited for their use due to the short range and the considerable separation distance which is required for the electrodes.

Technical Information

"For electric current communication it is necessary to have two pairs of electrodes, each pair of which can be used as a sender or receiver. Audio-frequency currents (they may be speech or signal tone) are introduced into the water from a suitably designed amplifier (or oscillator) and a transformer connected to the two electrodes in the water. When the current flows through the conducting medium, an alternating e.m.f. will be found to exist between two other electrodes placed in the water. The received signal is then amplified in earphones." This system apparently is unaffected by ocean currents, surf, and the noise of ocean craft, marine life, etc. In a typical test, speech is intelligable over 500 m. with the electrodes 35 m. apart and the current 0.7 amp. The range is a direct function of the distance separating the electrodes. The electrodes most frequently used consist of metal braid stretched over rubber tubing and a long-life stainless steel or nickle is preferred.

In the Sleeping Beauty application the electrodes were fixed to the bow and stern whip antenna. In other applications such as from shore to ship, the electrodes are placed with the requisite spacing by mounting on floats, while a swimmer could mount one electrode on his forehead and trail the other on a long wire behind.

One of the chief difficulties encountered was the waterproofing of the sets and their installation. Although the Sleeping Beauty is electrically driven, the UWT has its own power supply and is entirely divorced from the system of the undersea craft.

Models were constructed which could be used by a swimmer, but it is believed that the full potentialities of the UWT had not been explored at the time when the work was stopped.

Problem Submitted: October 21, 1942. Problem Terminated: June 30, 1945.

Contract: OEMsr-922 [redacted] (b)(3) NatSecAct

Final Report: Division 19 Serial No. 12, Part V, "A System of Short Range Communication by Passing Audio-Frequency Electric Currents through Water," dated June 1945, submitted to [redacted] on October 2, 1945.

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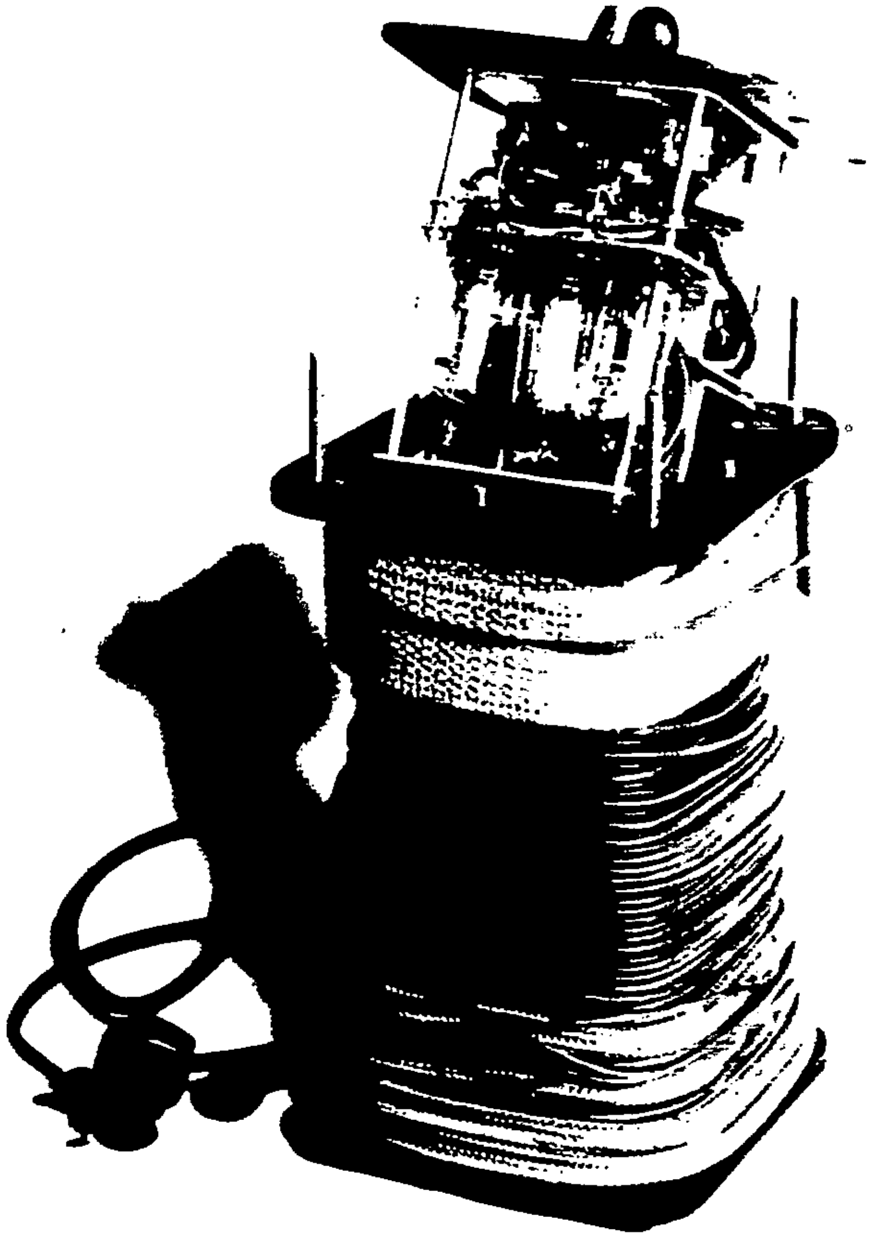
(b)(6)

Patent Report: Forwarded [redacted] on October 11, 1945.

(b)(3) CIAAct
(b)(6)



Part V: Miscellaneous Devices

In addition to the specific and important devices described above, the contractor has reported on the results of his work on a number of items as follows:

1. A small free field room for high frequency acoustical measurements. This was constructed at low cost and in a small space as a work room where high frequency studies were made.

2. An ultrasonic condenser microphone. This was constructed for use in the absolute measurement of sound pressure, the determination of acoustic radiation patterns, and the calibration of other microphones.

3. An ultrasonic whistle and other acoustic generators. These were developed in connection with the Canister Locator and short range communication and patrol problems.

4. Underwater acoustic devices. These included the underwater hooter, bell, Klaxon, and acoustic dipole.

5. Short distance signaling by means of X-rays and Gamma rays. A portable Geiger Counter was devised and experiments run to determine whether radium and similar materials would solve the Canister Locator problem.

6. Audio-noise source. This was built to provide a frequency distribution of power which is nearly constant throughout the audio-frequency range.

7. Detection of signals by means of a sensory vibration receiver. This VST provided a method of reception for the IFT which did not depend upon the ear, but rather on vibration of a plate fixed to a less conspicuous spot on the body.

Details on all of these will be found in Part III of the Final Report, Division 19 Serial No. 12, "Report of Miscellaneous Devices," dated June 1945, which was submitted [redacted] on October 2, 1945.

(b)(3) CIAAct
(b)(6)

SAC-5 RAINBOW

Operational Background

Throughout clandestine operations, it is frequently desirable to place agents in enemy territory by landing from aircraft or from ships and submarines on the enemy shore. Such operations are attended by difficulties in locating suitable spots, possibly pre-arranged, where the landing is desired. There is also difficulty in making contact and picking up the agent after his mission has been performed. Since most of these operations are carried out at night, when it is advisable not to use visible means of signaling, the need for ultraviolet and infrared apparatus arises.

General Statement of the Problem

At first the problem requested study and evaluation of four methods of communication which were suggested, namely: the Schmidt Ultraviolet Camera; Thermistors, operating on infrared; inoptiscopes, operating on a faint visual light and on infrared; and lastly, ultra-high frequency devices. In actual practice the problem was considered simply as covering infrared and ultraviolet communication devices in general. Ultra-high frequency signaling was later on incorporated as part of problem SAC-4, where it has been discussed (MWT).

Historical Background

As arranged when the Director's Subcommittee was set up, it will be recalled that Mr. Lovell was the sole liaison for OSS and Dr. Chadwell, for OSRD. For this reason, [redacted], who was a communications officer in OSS concerned with problems similar to those given above, formally requested through Mr. Lovell the cooperation of NDRC in evaluating the three devices specifically mentioned above. This request was forwarded to Division 19 on October 21, 1942, and through Dr. [redacted] contacts were established and channels cleared for [redacted] to discuss the problems directly with those in NDRC who were acquainted with the field.

(b)(3) CIAAct
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These contacts were chiefly with [redacted] both of whom at that time were in Section C-6. The first contacts which came in November and December 1942 were made by [redacted] with [redacted] [redacted] This work was largely in the nature of a demonstration [redacted] of prism equipment, previously developed by [redacted] and later used in [redacted] special application for assistance in the night landing of aircraft. At the time, these prisms were used

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(b)(3) CIAAct
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(b)(3) NatSecAct
(b)(3) CIAAct
(b)(6)

with visual signals, but it was recognized that they would respond similarly to infrared. These devices were entirely to the satisfaction of OSS and were put into production. Through the assistance and advice of [redacted] (b)(3) CIAAct (b)(6) the procurement was greatly facilitated, and by April 1943 devices were used in the field with success. When the reorganization of NDRC took place, [redacted] (b)(3) CIAAct (b)(6) became associated with Division 16, and a significant extraction from a Division 16 report is included below under "Technical Information."

(b)(3) CIAAct (b)(6) In addition, [redacted] advised [redacted] from time to time on infrared equipment in general and presented him with samples of inoptiscopes. The thermistor was never the subject of extended tests, apparently not being suited for the purpose originally suggested, namely, the location of and communication with a man by the use of a device having a resistance with a large temperature coefficient in a suitable collecter based on infrared reception.

The Schmidt Camera and ultraviolet devices in general were also discarded from further consideration as being impractical.

(b)(3) CIAAct (b)(6) [redacted] contacts with [redacted] extended beyond the period of NDRC reorganization and were most numerous at the time when [redacted] was Chief of Section 12.1. On March 11, 1943, [redacted] carried out large scale tests at Area D, an OSS camp in the vicinity of Washington. (b)(3) CIAAct (b)(6) These tests were limited entirely to infrared equipment and were so promising that [redacted] (b)(3) CIAAct (b)(6) requested the assistance of [redacted] in locating manufacturers and in getting into production.

(b)(3) NatSecAct

This was done, and an OSS order was placed [redacted] for the production of a number of infrared communication devices similar to the NAN of the Navy. These electrolytic infrared receivers were designated as C-2, and (b)(3) CIAAct (b)(6) their production was greatly facilitated by the assistance of [redacted] (b)(3) CIAAct (b)(6) and [redacted] in securing clearance from the Navy for their release to OSS. At the same time there was assistance rendered [redacted] by the [redacted] (b)(3) NatSecAct [redacted] While OSS purchased the C-2 equipment directly, there were various expenses connected with facilitating production and demonstrating equipment, and to cover these Division 12 proposed to NDRC two contracts: (b)(3) NatSecAct one [redacted], and the other [redacted] (b)(3) NatSecAct These contracts had the approval of NDRC in the middle of June 1943, since they were entirely under the jurisdiction of Division 12, no details of them are given here.

(b)(3) CIAAct (b)(6) It is sufficient to say that by that date the apparatus had been delivered to [redacted] and the problem had in essence been completed. [redacted] continued contacts with [redacted] from time to time. The problem was finally terminated ~~on April 26, 1944~~, with the assistance on two items having been rendered: [redacted] help with prisms in the night landing problem and [redacted] assistance with metascopes. The (b)(3) CIAAct (b)(6) Division was assured by [redacted] that these had been significant contributions.

Technical Information

All of the apparatus mentioned in this problem were the developments of other Divisions of NDRC and are therefore not described here. Their details were never known to the Division because the liaison was entirely between [redacted] and because at that time a very high security had been imposed by the Navy on such equipment. It is of interest, however, to quote an excerpt from a Division 16 report of April 16, 1943, which describes work done by [redacted] under a [redacted] contract; these devices have already been mentioned above, and it is understood that they became of considerable interest to the Corps of Engineers and to the Navy at a later date.

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(b)(3) CIAAct
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> "In addition to ultraviolet systems there has been developed, at the request of the Office of Strategic Services, a system using a very similar visible light carried on the pilot's head with triple prism autocollimators as ground mirrors. The total weight of the aircraft equipment in this system is two pounds. The security is less than that of the ultraviolet system, but the useful range is also about one mile. This system has been adopted by the OSS and an order placed for 300 aircraft and 1000 ground units. The latter consist of triple prisms for which rapid manufacturing procedures have been developed under Contract OEMsr-698" [redacted]

(b)(3) NatSecAct

Problem Submitted: October 21, 1942. **Problem Terminated:** April 25, 1944.

Contract: None.

SAC-6 BRIMSTONE

Part I: General

Operational Background

The value of fire in subversive warfare is so obvious that no detailed discussion is required.

At the time when the Director's Subcommittee first began to function, there already existed a few convenient fire-raising devices which had been developed by the British. These were not of such a nature as to inspire confidence in the operators, and possibly for that reason or because fire is not as immediately destructive and spectacular as high explosives, the whole field of fire-raising was a much neglected art. This was in spite of the obvious advantages which fire has for saboteurs. These advantages lie in its silence, its simplicity to the operator, and the enormous destruction which can be caused if a fire reaches the stage of conflagration without warning having been given.

The conviction was strong that this field of warfare merited a large program, and as will be seen below when the different devices are discussed, a variety of successful gadgets and techniques was developed.

General Statement of the Problem

At the request of OSS, Division 19 undertook to study and develop various incendiary devices suitable for their operations. The results of this program are taken up below under the various headings.

Part II: Pocket Incendiary (PI)

(b)(3) CIAAct
(b)(6)

Historical Background

(b)(3) NatSecAct

Among the items of interest [redacted] when contact was first established with OSRD in May 1942 was a device known as the [redacted] Candle. This unit, bearing the designations H-1 or M-1 Fire Starter, had been developed under a Division 11 contract [redacted] (OEMsr-179) by [redacted] and was accepted and in production by CWS. A brief description of it in an OSS catalog sheet is appended at the end of this discussion.

(b)(3) NatSecAct (b)(3) CIAAct (b)(6)

This device consisted of a cellulose nitrate cylinder filled with petroleum jelly made of Napalm and Stoddards's solvent. Under its cap at the top of the filling was a matchhead button and above that a match scratcher. This allowed its ignition by striking the matchhead across the scratcher, whereupon it instantly flamed up and continued to burn for four to six minutes with a hot flame. Operationally it was useful to CWS and ground troops in general for starting camp fires and was very effective even on wet or green wood. This unit seemed to OSS and Division 19 to be a likely starting point for the solution of their particular problem.

There were also at the same time other incendiaries which it was felt warranted consideration. These were the M-50 and the M-52 incendiaries, both of which were thermit bombs which depended upon the reaction between concentrated sulfuric acid and a sugar-potassium perchlorate mixture, as well as devices developed [redacted]

(b)(3) CIAAct
(b)(3) NatSecAct
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A joint CWS-NDRC group therefore convened at Edgewood Arsenal on November 30, 1942, to determine which of these ideas appeared most promising for OSS operations. A number of experiments were run in which the different units were used to attack dry and wet packing cases, and it was concluded that "the thickened hydrocarbon type of incendiary candle is more effective than more complicated mixtures." It seemed further that "of the above preferred type the already standardized M-1 is definitely the best on a weight as well as a volume basis."

(b)(3) NatSecAct

This successful demonstration was followed on December 18 by a meeting at [redacted] in which Mr. Lovell representing NDRC, [redacted] (the inventor of the M-1), [redacted] and others were

(b)(3) CIAAct (b)(6)

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present. It was decided that the M-1 should be revamped in a form more convenient for pocket carrying, and the preferred size was given as 5 by 2-3/4 by 3/4 inches. It was decided also that space should be provided on the side of the case for the attachment of a time delay Pencil with a suitable means of initiating the case thereby.

It was the last point that proved the most difficult part of the adaptation. It was relatively easy to make wooden molds and form celluloid cases; it was relatively easy to fill these, if the Napalm were introduced into the case before the addition of the hydrocarbon and gelation occurred inside the case; but it was not found so easy to develop an ending for the standard Pencil which would reliably ignite the case when the Pencil fired and would do so silently. This latter point ruled out the system which had previously been used in the British type incendiary where the action of the Pencil was normal, a percussion cap being struck and safety fuse ignited therefrom.

So important did the question ultimately become that a special contract was negotiated with the [redacted] Corporation, and the problem of the matchhead is treated below as a separate item. (b)(3) NatSecAct

On January 6, 1943, [redacted] (b)(3) NatSecAct an informal report in which the M-1 Fire Starter was compared with the standard British thermit pocket incendiary. There was no question of superiority of the former, which reaffirmed the decisions reached at the tests at Edgewood.

At about the same time, the Pocket Incendiary emerged in its final form. This was reported upon in a Division 11 progress report, OSRD No. 1211, dated February 19, 1943, for all the work on the development of the Pocket Incendiary was handled under the Division 11 contract at a time when the Director's Subcommittee had not yet begun to function.

On January 22, 1943, [redacted] delivered to OSS 43 completely assemble(b)(3) CIAAct PI's, and at the same time was asked to prepare 1000 additional units f(b)(6) experimental purposes. Specifications were drawn up on February 5, and on February 25 it was learned that OSS had standardized the PI and that production would soon begin on an order for 400,000.

Believing that the pocket incendiary might be useful to other Services, the device was introduced to the Army Ground Forces on February 8, 1943, through the office of General C. C. Williams, NDRC Liaison Officer for the Army. As a result, 20 samples of the PI equipped with delay Pencils and 20 packed with pull igniters were sent to the Mountain and Winter Warfare Board at Camp Hale, Colorado, for trial. At about the same time, the improved incendiary was brought to the attention of the Army Air Forces, since they had expressed interest in the Chicago incendiary, and later a shipment of 40 samples was made to Wright Field. In June of 1943 still further samples were brought to the attention of the Maritime Commission, it being thought that they might find the device useful in starting fires in life boats or for signal purposes. From none of these Service contacts, however, did any further interest develop.

There were essentially no further developments on the PI exclusive of the matchhead ignition system, which is discussed below.

It was the feeling of those in the Division that a very satisfactory fire starting device had been developed and put into production, and it was gratifying to learn that large numbers of these eventually reached the field and were put to good use.

Technical Information

[redacted]

(b)(3) NatSecAct

Problem Submitted: November 21, 1942. Problem Terminated: June 8, 1945.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Contract: OEMsr-179 [redacted] official investigator; transferred from Division 19 budget to Division 11 budget, $8,000.

Final Report: Division 11 Serial No. 1211, issued as a progress report under Contract 11-186, OEMsr-179.

(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded [redacted] on September 8, 1943: Records of Invention. Serial No. 536,798, "Pyro Technical Devices" by [redacted], filed by the Legal Branch of CWS.

(b)(3) NatSecAct

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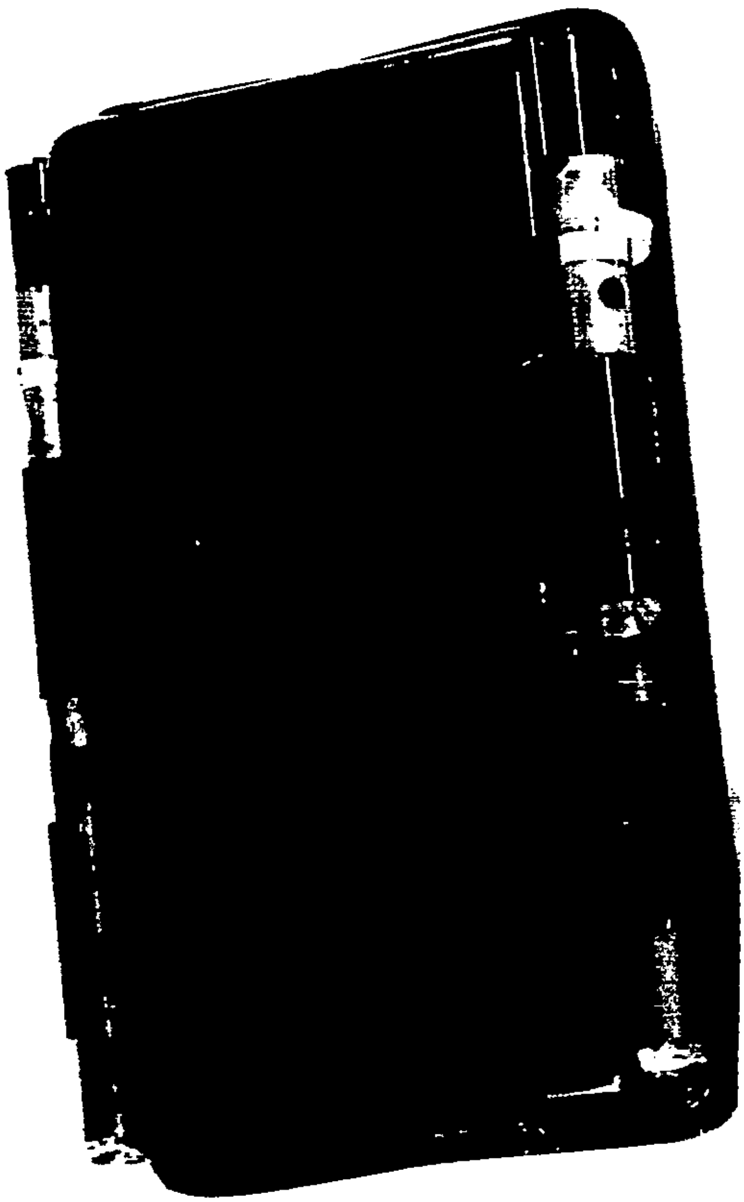
(b)(3) NatSecAct



Approved for Release: 2018/06/04 C02393825

Part III: Matchhead

Historical Background

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(b)(6)

It was required that the pocket incendiary should be silently initiated by the time delay Pencil. This device ordinarily operates by a plunger striking a percussion cap and is therefore far from silent. Therefore as part of the development of the PI [redacted] undertook the simultaneous development of a silent method of initiation. This was finally accomplished by the substitution for the primer of a specially constructed matchhead, and in its original form was essentially complete by January 1943. An illustration of this original matchhead and its various components appears later. Basically the matchhead consisted of a black celluloid tube filled with powdered potassium chlorate, in which was embedded the head of a "Strike Anywhere" match. This unit was sealed against humidity by a thin celluloid plate, and the Matchhead was crimped into the end of the standard Pencil. The result was the so-called SRI (Signal Relay Incendiary).

Only one other change was required in the standard Pencil, and this was in the striker. The striker, which was suitable for the percussion cap, was not suitable for the Matchhead, and accordingly was replaced by a new striker having a pin point and a crown shoulder perforated to allow release of gas and thus to prevent explosions.

(b)(3) CIAAct
(b)(6)

The large order of 400,000 incendiaries was originally made using this celluloid Matchhead. After large-scale tests of the production lot began at MRL, it became apparent that 8 percent duds could be expected. This was considered very serious at the time, and [redacted] was asked to determine the cause. A meeting was held on July 13, 1943, attended by representatives of the [redacted] Company (the manufacturers of the PI) and the [redacted] (b)(3) NatSecAct the manufacturers of the Matchhead), and it was decided that a contract between (b)(3) NatSecAct NDRC and the [redacted] should be undertaken for the development of an improved Matchhead.

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(b)(3) NatSecAct

At the same time [redacted] continued his experiments, attempting by X-ray examination to locate some fault in the manufacture of the product. In this he was not successful, and it was decided that humidity must be responsible for the misfires and occasional explosions which were being encountered. Through the cooperation of [redacted] under Contract OEMsr-545 with [redacted] (SAC-17), this was found to be the case.

(b)(3) CIAAct
(b)(6)

Simultaneously, [redacted] discovered another source of difficulty; this lay in the shape of the pointer on the special striker. It had been noted that a test jig which had been used repeatedly for the testing of Matchhead production gave much higher percentage operation than the Pencils themselves, and this suggested that a striker which had become roughened by repeated use might be better than a perfectly smooth new striker. Tests established this, for when smooth strikers were coated with an abrasive binder the number of misfires was reduced. At the same time, it was found that the angle point of the striker was important, a 45° angle being best.

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These changes in the plunger points were beneficial but did not entirely answer the problem, inasmuch as the humidity effect still had not been overcome.

Attempts at moisture-proofing the celluloid Matchhead continued through August, and by the end of that month a fairly successful procedure had been worked out involving wax and the use of a thicker sealing window. All of the SRI's in stock were, in the course of time, reconditioned by the application of these new discoveries, and exhaustive tests at MRL demonstrated by the end of 1943 that a celluloid Matchhead had been developed which would function reliably 98 percent of the time and which would survive most drastic cycles of tropical exposure.

OSS Procurement, upon the advice of MRL and [redacted], reconditioned a(b)(3) CIAAct (b)(6) PI's in stock by the addition to the case of a second SRI using the perfected celluloid Matchhead. Such units are expected to operate over 99 percent of the time, since the matchheads are quite capable of withstanding any reasonable conditions of humidity and temperature which they are likely to meet during the period when the time delay is functioning.

To insure their arrival at the point of use in this perfect condition, each PI was packaged individually in a sealed metal container to be opened only at the point of use. The decision to use this type of package was reached in early 1944, after a long series of attempts by Dr. Fieser to develop a waterproof pasteboard container sealed by dipping in various types of wax and lacquers. Although pasteboard packages comparable to those used in K rations were developed and even improved, it was finally concluded that only metal would withstand the rough handling and tropical conditions to which the devices might be expected to be exposed.

(b)(3) NatSecAct

As mentioned above, the meeting [redacted] the decision to continue research by the [redacted] with cooperation between the laboratories [redacted] and MRL in the testing [redacted] an improved Matchhead. By December 1943, the [redacted] had produced a Matchhead very similar in general appearance and construction to the celluloid head but made of magnesium. Several hundred of these Matchheads were made from time to time and tested at MRL (MRL Reports No. 34 of January 22, 1944, and No. 33 of February 5, 1944) under the most drastic cycling conditions of humidity and temperature. MRL Report No. 70 of April 12, 1944, however, reported failures in humidity exposure, and it was not until June 27, 1944 (MRL Report No. 98) that this difficulty was traced to the waxed seal which closed the Matchhead. Discovery of a suitable wax was not long in coming.

(b)(3) NatSecAct

There then resulted a Matchhead which was demonstrably superior to the celluloid Matchhead in resistance to adverse conditions. To prove this, Division 19 authorized the contractor to produce 10,000 units which were completed by October 1944, when the entire quantity was delivered to MRL. Of this number, approximately 5000 were later given to OSS for field testing and a large number of the remainder were used by MRL for incendiary experiments.

These experiments resulted in MRL Report No. 184, which demonstrated that the magnesium Matchhead was an excellent incendiary device in itself, in addition to being superior to the celluloid Matchhead when combined with the Pencil or a PI. "It is probably worth pointing out also that the magnesium-headed SRI is ideally adapted for such special uses as the silent time delay ignition of flares, smoke pots, incendiary bombs, and the like." Although this report indicated the value of the magnesium Matchhead and although it had been demonstrated to be superior to the celluloid head, it was never put into production because of the progress of the war and the cancellation of a British production order for several hundred thousand during the optimistic days of late 1944.

Technical Information

1. The Celluloid Matchhead. The accompanying illustration makes quite clear the construction of this device, and it is not felt necessary to amplify it here, except to comment on the reconditioning treatment which was found to improve the moisture resistance. This was accomplished by dipping in a thermo-plastic wax developed by Dewey and Almy and designated by them as TP317. This material is described by them as tough and strong and having good mechanical properties over a temperature range between 30° and 150° F.

2. The Magnesium Matchhead. This consists of a magnesium shell approxi- [redacted]

(b)(3) NatSecAct

Problem Submitted: October 21, 1942. Problem Terminated: June 8, 1945.

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(b)(3) NatSecAct
(b)(6)

Contract: OEMsr-179 [redacted] official investigator; work on the Celluloid Matchhead done under Division 11 by direction.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

OEMsr-1119 with [redacted] official investigator; July 1, 1943, to December 31, 1944; work on Magnesium Matchhead.

(b)(3) CIAAct
(b)(6)

Final Report: Division 19 Serial No. 28 (OEMsr-1119) submitted to [redacted] [redacted] on March 12, 1945.

(b)(3) CIAAct
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(b)(3) CIAAct
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(b)(3) CIAAct
(b)(6)

Patent Report: OEMsr-179 on Celluloid Matchhead, Serial No. 536,799, "Munition" by [redacted], filed by the Legal Branch of CWS; Record of Invention forwarded to Captain [redacted] on September 8, 1943, OEMsr-1119 on Magnesium Matchhead forwarded to Captain [redacted] on March 6, 1945; no inventions were made under the contract.

(b)(3)
NatSecAct

Part IV: City Slicker (NO-234)

Historical Background

During 1941 and 1942, the British [redacted] developed a [redacted] "C (b)(3) NatSecAct Mixture" (KOFQR) which was capable of igniting oil floating on water. It was used both offensively and defensively; in the former case, success— against Italian tankers torpedoed in the Mediterranean; in the latter case, in connection with the elaborate shore defenses built in England after Dunkirk. Included in these was a system of underwater pipes through which oil could be pumped and released on the surface of the water at strategic points close to shore. These floating oil patches were to be ignited by Cough Mixture [redacted] in the face of attempted invasio (b)(3) NatSecAct

It did not appear that either of these British developments had very much promise against such difficult targets as floating Bunker C crude oils unenriched with gasoline. At the same time, it seemed desirable to OSS that a simple igniter be developed for the use of saboteurs in attacking shipping in harbors. It was easy to visualize the "accidental" upsetting of barrels of oil into the harbor around piers and docks. Their subsequent ignition might have serious effects. Accordingly, in the fall of 1943 the problem was informally put to Division 19 to develop an oil slick igniter of minimum size and weight and of the greatest ease in operation.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

At first it was thought that perhaps the Pocket Incendiary could do the job, but later tests showed otherwise. The problem was then officially taken over by [redacted] and the first trial of two proposed designs was arranged on November 23, 1943, at the Navy Explosive Investigation Laboratory, Stump Neck, Maryland. [redacted]

(b)(3) NatSecAct
(b)(6)
(b)(3) CIAAct

In February 1944 a Major Charles Race of the Army Air Forces expressed interest in [redacted] work because of the problem current with that group requiring the ignition on water or land of belly-tanks of crude oil dropped by bombers. This problem was later solved by Service groups, and so far as the writer is aware the work reported here was of no assistance; it is mentioned simply because through Major Race the Navy became aware of NDRC work and eventually submitted a formal problem.

(b)(3) CIAAct
(b)(6)

This occurred in March 1944, when problem NO-234 was set up at the request of Commander J. F. Gallaher of COMINCH. As framed, the problem called for the development of a scatter bomb which would reliably ignite floating oil when released from an airplane traveling at speeds up to 300 miles per hour and at heights of over 1000 feet. It seemed too much to expect that the City Slicker in its pasteboard box could possibly fulfill this requirement; nevertheless clusters of these igniters were built up in bomb cases of the shackle type similar to the 100-pound M-50 incendiary bomb cluster. These were dropped at the Navy Testing Ground at Dahlgren, Virginia, on March 21, 1944, and surprisingly enough stood up well, apparently being slowed down in the air stream sufficiently to survive the shock of impact. The shape was, however, not convenient, and at Commander Gallaher's suggestion a triangular model with reinforced corners was developed.

The tests showed two other deficiencies in the igniters which were serious in the opinion of the Navy. These concerned safety of the units in the plane before dropping and quickness of action on hitting the water. Quite rightly the Navy felt that since the filling of the igniter reacts spontaneously with water an entirely waterproof case would be required up to the moment when the unit left the plane. At the same time it was desired that once the unit had struck the water it function in a period of less than 15 seconds and ignite the oil strip immediately to prevent interception by defenders.

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Numerous trials [redacted] of different mixtures and different arrangements of the carbide booster, as well as numerous attempts at the development of an entirely waterproof cardboard container occupied the time of the investigators for the succeeding several months, and the information gathered in an attempt to meet the Navy requirement was, of course, immediately useful in the perfection of the OSS unit.

In April and May, further tests at Dahlgren, Virginia, and Eglin Field, Florida, were called for by the Navy, and for these tests [redacted] provided 15 clusters of triangular units, each containing 24 igniters and sealed watertight until released from the plane. The Eglin Field tests were not entirely satisfactory, due largely to the manner in which they were conducted. It was concluded, however, that if the units could be dropped in sufficient number to form a large pattern they could be relied upon to set fire to floating oil.

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In June 15 clusters were supplied to OSS upon their request for field appraisal, and an additional quantity was given Commander Gallaher for a similar purpose. No word was ever received on the results obtained with the OSS supply, and those sent to the Pacific by the Navy were unfortunately lost.

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During all this activity on behalf of the Navy, [redacted] had not been idle with the original OSS problem and had extended the usefulness of the City Slicker by the development of a second method of ignition which would allow its use on land as well as on water. This unit was dubbed "Paul Revere" (PR, and if intended for water use could be activated as was the City Slicker or if intended for land use could be activated by an SRI inserted in an attached celluloid case filled with Kraus mixture, a free burning pyrotechnique.

A full demonstration of all types of oil slick igniters was conducted at MRL on May 2, 1944, at which time it was concluded that the igniters were capable of setting fire to pools of crude oil either floating on water or contained on land. The possible use of Paul Revere, at least as a hand incendiary competing with the PI, was also realized, because it contains [redacted] (b)(3) NatSecAct

As a result of this demonstration, OSS desired that NDRC undertake the semi-production of a quantity of 1000 units, and arrangements were made by (b)(3) NatSecAct [redacted] to fulfill this through a direct purchase order [redacted]

While the order was being filled, OSS arranged a very large scale test at Beach Haven, New Jersey, for the 10th of June 1944. At that time a slick of 1000 gallons of Navy Special Oil was dumped and successfully ignited by City Slickers, the whole being filmed by the Field Photographic Group of OSS. It was definitely determined that one City Slicker would be sufficient to ignite an oil slick in a period of two minutes and that once this has occurred the fire spreads with great rapidity but is of only short duration (in this case, seven minutes). It was also concluded from these tests and calculations that it would be impossible to ignite an oil slick which is less than 1/10-inch in thickness.

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The semi-production units from the [redacted] order, packed in steel boxes with rubber gaskets, reached MRL for trial in July. The quality was quite inferior to the earlier test models which had been prepared in the (b)(3) NatSecAct [redacted]. Indeed, it was apparent that these units were entirely unsuitable, because during their manufacture the mix or calcium carbide booster had become inactivated by moisture and the units, while not dangerous, gave a very poor percentage of function. The units tested were both the Navy and Paul Revere types.

Several MRL reports were issued, and it was decided on the basis of these that the only safe way to ship Paul Reveres and City Slickers was in sealed metal containers similar to those supplied. It was also concluded that the manufacture of the units should be conducted in a less humid atmosphere (b)(3) NatSecAct than encountered [redacted] and that certain minor modifications were desirable in the waterproofing and sealing of the pasteboard boxes. The units remaining from the test program were destroyed, and arrangements were made for a second semi-production by the [redacted] (b)(3) NatSecAct in San Jose, California.

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[redacted] took personal charge of this work, and with the excellent cooperation furnished by the company successfully completed the second semi-production of 1000 units by November 1944. With the able assistance of [redacted] of the corporation, the semi-production was very rapidly conducted in a special building assigned for the purpose, and with especially controlled conditions for the manufacture of the mix, the loading of the units, and their subsequent sealing and packing in ammunition cases.

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Adequate samples of this production were forwarded to MRL for appraisal and passed with flying colors a most rigid acceptance trial including rough handling and tropical weathering.

As a result, OSS in December 1944 placed a further order with the [redacted] (b)(3) NatSecAct (b)(3) NatSecAct [redacted] for the production of 10,000 units with every confidence that the units produced would function reliably even after long exposure to the conditions of transportation and storage in the tropics.

During the latter half of 1944 the Navy interest in the problem diminished, and upon the departure of Commander Gallaher for other assignments the problem came to an end without adoption by the Navy. For this reason the entire (b)(3) NatSecAct [redacted] pilot order was for Paul Reveres, since these were of greater value to OSS than the Navy type, City Slicker.

Technical Information

"The City Slicker is a device for affecting the ignition of oil slicks on water. [redacted]

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[redacted]

[redacted] (b)(3) NatSecAct

Problem Submitted: OSS problem, January 22, 1944; Navy problem (NO-234 Oil Slick Igniters), March 13, 1944.

Problem Terminated: OSS problem, June 8, 1945; Navy problem, January 27, 1945.

Contract: OEMsr-1214 with [redacted] (b)(3) CIAAct official investigator; November 15, 1943, to May 31, 1945. (b)(3) NatSecAct (b)(6)

Final Report: Division 19 Serial No. 30, Part II with City Slicker and Paul Revere, dated May 28, 1945, submitted to [redacted] on July 21, 1945. (b)(3) CIAAct (b)(6)

Patent Report: Not completed when this volume was prepared.

Part V: Arson Manual

Historical Background

American visitors to SOE stations in England were interested to note that while an elaborate course in the use of explosives was given to operators including actual laboratory work with scrap machinery in the proper placement of charges, no training was given in arson. This seemed to be a blind spot, and the need for an adequate course of instruction in the use of incendiaries became increasingly apparent as time went on.

The British group were themselves aware of this lack and were in the process of preparing a field manual. Accordingly, although OSS was in need of such a document for immediate use as early as February 1944, it was decided that no American work on its preparation would be undertaken until the British manual had been received and evaluated. In June this manual, "Laboratory Contribution No. 63, [redacted]" arrived in the United States and was sent to [redacted] for appraisal. It appeared from their comments, as well as from OSS reaction, that the manual was not entirely in a form to suit OSS needs, being on the whole too technical and not stressing sufficiently, in the minds of American workers, the use of simple and readily combustible materials which might come to hand.

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[redacted] was well suited to give an opinion on the subject, since he had a large professional background in fire prevention, had been very active in Division 11.3, and had prepared in the latter part of 1943 a memorandum on the subject for Mr. Lovell. Moreover, he was chairman of a committee which, under the auspices of the Army Air Forces, investigated various Boston plants on April 5 and April 6, 1944, to determine the targets which they would present to incendiary aerial attack. He did not feel able to handle the preparation of an OSS manual, however, and [redacted] fortunately was interested.

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One other item of background information was uncovered at about this time. This was a publication for the U. S. Marine Corps of a booklet entitled "Destruction by Demolition, Incendiaries, and Sabotage." This interesting manual attempted, in one section at least, to set forth the principles of fire raising. The point of view, however, was essentially amateurish and clumsy from the compleat saboteur's standpoint.

With all the background information at hand, a meeting took place at OSS on the first of August 1944 to determine whether Division 19 was to prepare an American manual and the nature of it. It was definitely decided that [redacted] should be requested to write such a pamphlet, and suggestions were made by OSS officers on the content of it.

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In order to gain information at first hand, [redacted] availed himself of test structures set up at [redacted]. From a study of these, he deduced the basic principles of arson, and during the last part of August 1944 had the opportunity of putting these to test during the TVA project (SAC-49). Several houses were available and through the use of these houses and a certain amount of second-hand furniture [redacted] His experiments were photographed by the Field Photographic Branch of OSS, and a moving picture on the subject was later released for training purposes.

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On January 5, 1945, [redacted] rough draft of the proposed manual was received, and on January 23 a gathering of OSS, SOE, and NDRC personnel decided on its final form and content. It was at this time arranged that it would be printed by the Presentation Section of OSS, and the manuscript was delivered into their hands early in March 1945. Three hundred copies of it were produced and finished by the first of July 1945 and distributed by OSS to all interested parties, including the Marine Corps, the FBI, SOE, and Divisions of OSS.

Technical Information

The Manual is divided into the following general sections:

1. The Introduction. A very brief exposition of the great value of incendiary attack is given. It might seem that this was superfluous, but experience has shown that the usual operator is more eager to use high explosives even in attacks where fire would definitely have greater potential damaging power.

2. Part I, Principles of Fire Starting. These include the location to be selected, contributing factors which facilitate the spread of fire, and deterrence factors.

3. Part II, Practical Operations. On the basis of principles, this section suggests arrangements of incendiary material to insure success and selection of targets which are vulnerable.

4. Part III, Incendiary Stores, describes in detail the various devices standard with OSS and SOE. Included are the CWS M-1 Fire Starter, the PI, the PR, the Well, British Incendiary Blocks, Mark I and II, Incendiary Packet, Capsules, and improvised use of the M-50, M-52, and M-69 Incendiary Bombs. Advice is also given the agent on the use of incendiary materials which he may secure in the field.

5. Part IV, Improvised Time Delay Devices is drawn entirely from MRL Report No. 215 [redacted] Instruction is given in a number of simple arrangements of readily obtainable materials which will produce time delays and eventually fire.

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The Manual is extensively illustrated with pictures of test structures designed to demonstrate the principles. There are also a number of views of attacks on such targets as dwellings, furnished rooms, dumps of packing cases, attic structures, and the like. Lastly, the individual devices and the improvisations of Part IV are shown.

Problem Submitted: August 1, 1944. Problem Terminated: June 8, 1945

Contract: OEMsr-1214 [redacted] (b)(3) CIAAct
official investigator; November 15, 1943, to May 31, 1945. (b)(3) NatSecAct
(b)(6)

Final Report: Division 19 Serial No. 30, Part IV: "Arson an Instruction Manual," submitted [redacted] on July 21, 1945. (b)(3) CIAAct
(b)(6)

Patent Report: No inventions were made.

Part VI: Bat

Historical Background

Some time in 1942, Dr. Lytle S. Adams, a dentist residing in Los Angeles, submitted to the National Inventor's Council a suggestion for attack on Japan by bat-borne incendiaries. Dr. Adams believed that it would be possible to gather large numbers of bats from Carlsbad Cavern in New Mexico, equip these bats with small incendiaries to be activated by suitable time delays, and then to release the incendiary-carrying bats close to the shores of Japan, either from submarines or from aircraft.

The transportation of the bats from the loading point to the scene of operations was to be accomplished by the use of refrigerator units, for it was known that the bats went into hibernation in cold temperatures, and they did not then require food or attention. It was believed that they could be brought back to activity very rapidly by a simple rise of temperature. This bazaar idea received serious attention, it was rumored due to Dr. Adams's contact with certain residents of 1600 Pennsylvania Avenue. At any rate, the problem first came to the attention of NDRC in March 1943, when General W. C. Kabrich, Chief of the Technical Division of CWS, requested the assistance [redacted] in developing a suitable small incendiary unit for this highly secret purpose. (b)(3) CIAAct (b)(6)

Since [redacted] was at that time working under a Division 11 contract, OEMsr-179, the matter was referred [redacted] Chief of Division 11, who authorized [redacted] work. It was understood at that time that the cooperation of Division 19 would be required because of the need of development of a very light-weight time delay fuse. During this period the problem was in the hands of the Army Air Corps, and their CWS officer had put the matter to Edgewood Arsenal with the subsequent request for Dr. [redacted] cooperation. (b)(3) CIAAct (b)(6) (b)(3) CIAAct (b)(6) (b)(3) CIAAct (b)(6)

In May 1943 the continued interest of General Kabrich was emphasized, and a program of tests was arranged by Captain Wiley Carr of Edgewood Arsenal. These tests took place on May 15, 1943, at Biggs Field, El Paso, Texas, and Muroc Lake, California.

By that time [redacted] had, using the Pocket Incendiary as a guide, devised small celluloid cases filled with jellied fuel and bearing a cut-down type of Pencil igniter. The object of the tests was to determine whether the idea had any feasibility at all. From reports received through [redacted] it appeared that the suggested plan was on the borderline of feasibility, chiefly because of the erratic behavior of the bats, who did not respond hibernation as expected and who could not be easily released from the aircraft without damage. (b)(3) CIAAct (b)(6) (b)(3) CIAAct (b)(6)

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It appeared that the incendiary unit devised [redacted] had, however, sufficient promise, so that it warranted further development if the problem were continued. The reaction of the Air Corps to the problem was not improved by the accidental burning down of several buildings during the test. However, on July 28, 1943, General Kabrich wrote further to NDRC stating that the Air Forces "have come to the conclusion that additional work m[redacted] be done before dropping the plan as impractical."

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To assist [redacted], arrangements were made [redacted] Los Angeles, to be brought into the problem, and the cooperation of [redacted] was secured under Contract OEMsr-876, which Division 19 had [redacted] Philadelphia. [redacted] function was to act as continuing liaison in California, where [redacted] and others interested in the plan were located, and [redacted] function was to perfect the time delay unit and specifically to make it as light as possible in view of the very limited carrying capacity of bats.

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In October 1943, the Bureau of Ordnance of the Navy Department suddenly and mysteriously entered the picture, requesting samples of dummy units, which were supplied. A return letter was received from Rear Admiral W. H. P. Blandy, Chief of the Bureau of Ordnance, on October 15 indicating no further interest by his group. It was surprising therefore to receive from General Kabrich on October 29 the request for continued cooperation by [redacted] and [redacted] with the U. S. Marine Corps Air Station at El Centro, California, as per the request of the Chief of the Bureau of Aeronautics, Rear Admiral D. C. Ramsey.

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It was at first thought that this problem would be handled under CWS-21, but later it was decided to handle it more informally on the basis of General Kabrich's correspondence and to defray further expenses under a Division 19 contract, which had been instituted [redacted] (b)(3) NatSecAct

There had been great confusion as to the time delay desired. Originally the problem had requested a 7-hour delay; this was changed to 17 hours, and still later to 24 hours. With the entrance of the Marine Corps into the direction of the work further requests were received for 30 minutes, 36 hours, and 48 hours, all of which quite naturally so complicated [redacted] work that it was decided that he should limit himself to the development of a time delay of 17 hours. This he eventually succeeded in doing, producing the so-called X-Ray Delay, which had fair qualities of reproducibility and reasonable lightness, the total delay including a magnesium matchhead coming to no more than 4.5 grams.

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During the same period, changes were made in the design of the celluloid case containing the jellied fuel, and [redacted] produced numbers of cases streamlined to the contour of the bat anatomy. Several thousand units were requested by the Marine Board for very elaborate tests.

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The feasibility of the Adams Plan seemed reinforced by results of static tests conducted [redacted] at Dugway Proving Ground on December 15, 1943, in the presence of Lt. Colonel Rhoads, the liaison officer of the Marine group at El Centro. In these tests the incendiary units developed by [redacted] were placed in Japanese type buildings in locations where it was believed bats would naturally seek shelter during the daytime. When these units were statically ignited in these locations very effective fires resulted, and [redacted] estimated that the weight efficiency for this type of fire setting was several times that to be expected from the conventional bombing attacks with M-50, M-52, and M-69 incendiary bombs. He estimated that the latter would produce somewhere between 167 and 400 fires per bomb load, while X-ray would give somewhere between 3,625 and 4,748 fires.

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It should be noted in this discussion that the NDRC activity was limited entirely to the development of a suitable incendiary and time delay. The problem connected with the bats, their storage and transportation and eventual release, were handled separately by the Services. It was understood that this was done in part through the cooperation [redacted]

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Just as the development of the X-ray time delay and its accompanying incendiary case had been completed, the Navy took formal action to terminate the problem as impractical, emphasizing ~~by~~ that the impracticality was due entirely to aspects of the problem beyond the control of NDRC. In March 1944 formal notice was received from the Navy, and the Adams Plan passed into limbo. On March 23 the problem was formally closed by CWS in a letter sent to General Kabrich by Dr. Chadwell.

The above problem had various names; it was generally called the Adams Plan, until it became a matter of such tremendous secrecy, when it was given the name X-Ray.

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(b)(3) NatSecAct

In the early stages before Division 19 activity began, [redacted] had been consulted with a view to determining the practicality of the idea from the point of view of payload which an average bat could be expected to carry. Before the end of the original Adams Plan, he came forward in July 1943 with the suggestion that rats be employed as bearers of incendiaries, and in July 1943 presented a report analyzing the possibilities and indicating that the common Norway rat could be expected to carry an incendiary load up to 75 grams and that this could be attached to the animal at the base of the tail in a position where he could not remove it. It was thought that these rats, which normally live in buildings, factories, and warehouses, would be an excellent way of introducing incendiaries into well guarded locations.

Needless to say, the question of making a suitable incendiary would not be difficult in view of the experience obtained with X-Ray. His suggestion was considered by OSS but was rejected as impractical.

Technical Information

The X-Ray time delay is discussed under SAC-17. The complete incendiary unit was found by tests with bats to have an imposed maximum weight of 15 g. The time delay, weighing 4.5 g., was not entirely dead weight, since it was largely magnesium, which would be ignited by the burning jellied fuel; the over-all weight of approximately 15 g. per bat was considered to be sufficient to set fire to the type of structure common in Japan, especially as the bats could be expected to seek out places where fire would be an especially favorable method of attack.

Before the plan was abandoned it had been ascertained that the manufacture of both the incendiary case and the time delay unit would be entirely practical in numbers of over a million units. On such a scale the cost of the time delay was expected to be not more than two cents and the cost of the incendiary in the same range.

Problem Submitted: March 19, 1943, letter of Brigadier General W. C. Kabrich to Dr. H. M. Chadwell, SPCVD-471.6 NDRC.

Problem Terminated: March 1, 1944.

Contracts: Division 11, Contract OEMsr-179 [redacted] (b)(3) NatSecAct
Division 19, Contract OEMsr-1214 [redacted]
[redacted] official investigator; November 15, 1943, to May 31, 1945.
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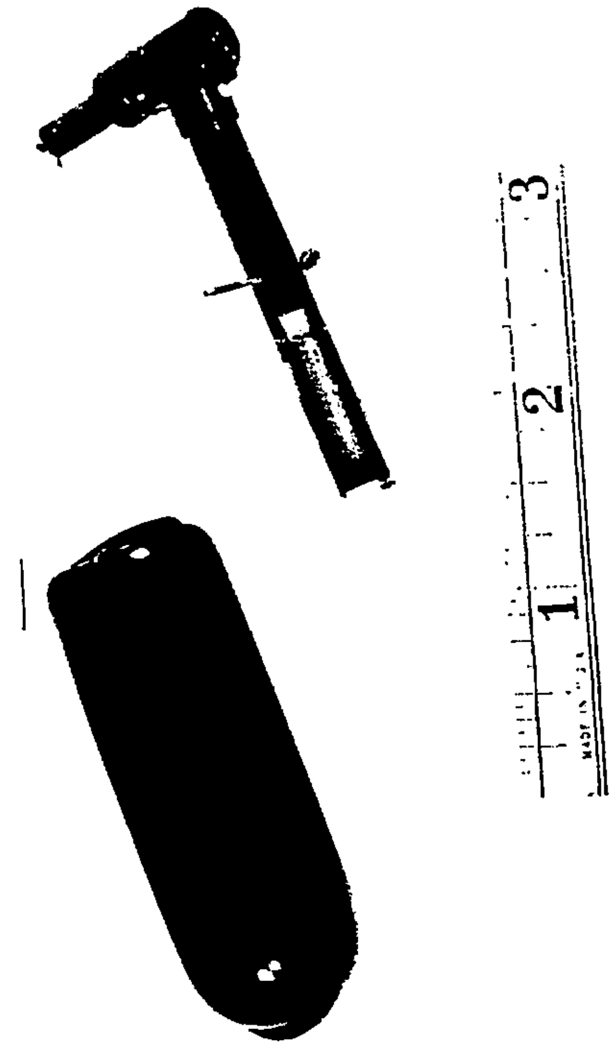
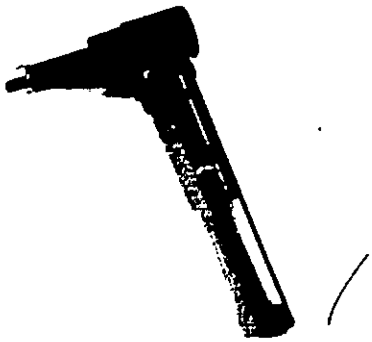
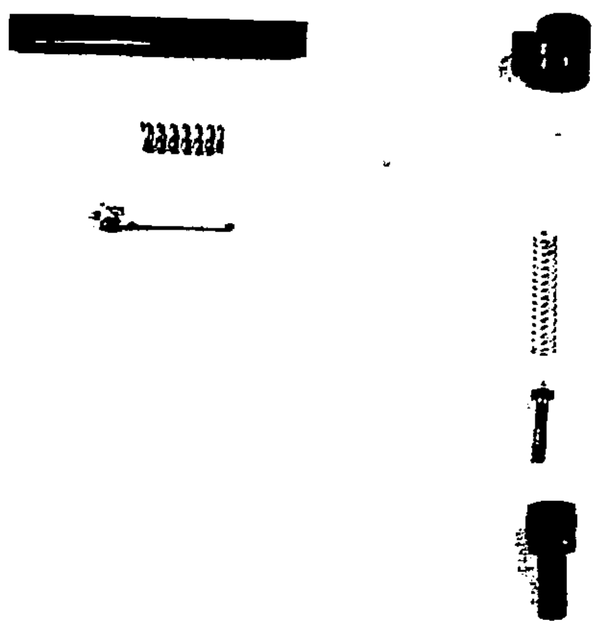
Most of the work was done under the latter contract.

Final Report: See SAC-17 for final report on the time delay; since the incendiary unit differed from the Pocket Incendiary only in dimensions, no report on it was required.

Patent Report: No inventions were made.







SAC-7 CANNON

Operational Background

It was considered by the British that a very useful weapon in the hands of terrorists would be a gun which at close range could be guaranteed to produce a successful assassination. For this purpose a maximum range of 60 feet was considered sufficient, and the suggestion was made of using standard ammunition such as 10-gauge shell loaded with chilled steel shot.

A perusal of history will reveal that many attempts at assassination failed because of the inaccuracy of aim of the assassin, presumably due to his extreme nervousness. Even attempts at very close range frequently failed entirely or resulted in, at most, superficial wounds.

The weapon desired would be one which even in the hands of a nervous person would result in success if pointed in the general direction of the victim.

General Statement of the Problem

The problem was to procure working models of weapons having the desired charactistics given above, the weapons to be of size and shape allowing for easy disposal and having a tenable recoil.

Historical Background

The idea was discussed at early meetings on August 25 and September 24, 1942, and eventually a formal request was received and considered at the first meeting of the Director's Subcommittee. By that time Mr. S. P. Lovell had already interested the firm [redacted] in Worchester, Mass., and had on hand a weapon partially developed by them. This pistol had a sawed-off shotgun barrel and accommodated a 12-gauge shotgun cartridge from which some of the powder charge had been removed. On firing from a mount a very good pattern was obtained on targets at 50 feet. No provision for absorbing the considerable recoil was made, however, and after several shots had resulted in an equal number of casualties among the users, the weapon was considered too dangerous for use and was discarded from further consideration.

(b)(3) NatSecAct

Subsequently, several meetings took place between Mr. Lovell and Colonel R. R. Studler of Army Ordnance, and it was thus discovered that a weapon existed which might meet the requirements. This was the so-called Woolworth Gun, a smooth bore .45-caliber pistol made of pressed steel at a cost of

approximately $2 each and available in large quantities, because it had been found unsuitable for the use of the regular Armed Forces. This weapon recommended itself still further to OSS as a way of arming friendly subjugated peoples of the Far East. Here it had value because it could be useful only for a short period before the humidity of the tropics would rust it away. In this way, it would be safe to arm people for the purpose of finding the Japs, while at the same time not giving them weapons which would later on be an embarrassment to the Allies.

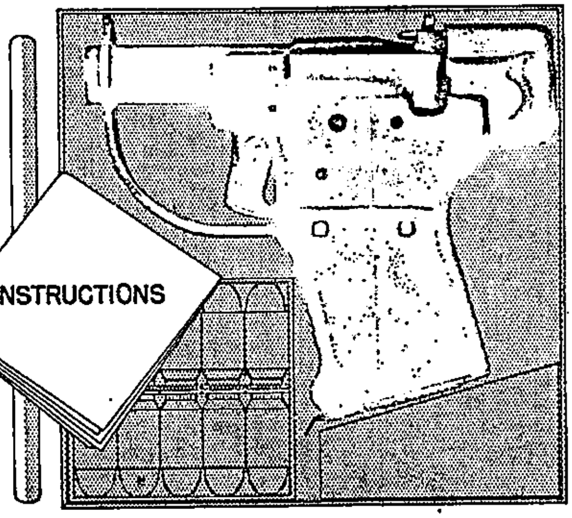
In May of 1943 it was reported by Mr. Lovell that he had secured the entire available supply of some 400,000 of these weapons and that they were to be listed as an OSS store. With the discovery of this available weapon, the Division terminated its interest in the problem.

Problem Submitted: October 21, 1942. Problem Terminated: December 24, 1942.

Contracts: None.

NOMENCLATURE: PISTOL, LIBERATOR, CALIBER .45

DESCRIPTION: The Liberator is an inexpensive, single shot, .45 caliber hand weapon, with a limited accurate range. Ten rounds of standard .45 caliber ball ammunition are enclosed with the gun in a waterproof carton. The ammunition can be carried in the butt of the pistol. A small stick is furnished to push the cartridge case out of the breech after firing. The accompanying pictorial instruction sheet needs no explanatory text.



DATA:

Length, overall	6 in.
Weight (including ammunition)	1 lb. 7 oz.
Number of pistols per carton	1
Number of cartons per case	20
Weight of filled shipping case	50 lbs.
Cubage	0.5 cu. ft.

ISSUED BY: OSS

ORDER AS: Pistol, Liberator, Cal. .45

SAC-8 WELL

Operational Background

The use of thermit as an incendiary material is not new, and indeed the first British incendiary issued for sabotage purposes was based on this substance. However, as indicated under SAC-6, thermit is not well suited for setting fires in comparison with other materials which are more slow burning and give a continuous source of heat over a longer period. In industry thermit is well-known as a cutting and welding agent for steel. With this thought in mind the British liaison officers desired that work be undertaken in this country to develop a device using thermit for attack on machinery of all types.

As originally posed, the operational need was for a device so simply constructed that the user would only have to place it in position, start his time delays, and leave. From an operational standpoint thermit was thought to have the great advantage of silence in contrast to high explosive which on the same targets would, without fail, arouse attention.

General Statement of the Problem

As first presented, the problem involved the development of a material, presumably ceramic, which in putty-like form could be molded on the object of attack to form a well or dam, in which the thermit on reaction would be confined. It was hoped that the molten thermit would evolve such heat that it would warp large pieces of machinery and crack and cut smaller pieces. As will be apparent below, the original objective was not met; instead, a self-tapping crucible delivering a stream of molten iron against the target was finally evolved.

Historical Background

In November of 1942 contact was made with various ceramic companies with the hope of exciting interest on their part and getting suggestions of materials which would be likely to have the desired plastic qualities and stability to intense and sudden heat. By these various contacts, two companies were interested in the problem; these were [redacted] Both of these groups very generously offered to work on the problem without contract, and in both cases a start was made using the standard CWS M-14 hand grenade. This grenade had dimensions of a soup can, was filled with approximately 2 pounds of thermate and equipped with a standard Bouchon fuse, and

(b)(3) NatSecAct

it was proposed to issue this as a standard source of reactant and in practice to mold the ceramic material around it on the target. A few tests with this idea were sufficient to show that it was entirely impractical, and it was suggested that an easier approach would be to supply the grenade with a jacket of asbestos or other material baked onto it, thus cutting down the amount of work required of the operator in the field to the bare minimum of shaping the support on which the grenade would stand. Experiments along this line were unpromising, and by February of 1943 the work [redacted] had shown so little success that it was mutually agreeable to terminate it.

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(b)(3) NatSecAct
(b)(6)

At about the same time, [redacted] came to the conclusion, on the basis of the experiments already performed, that the line of attack being followed offered little promise. There seemed no likelihood of finding a plastic, and at the same time a ceramic material, since most plasticisers were organic in nature and would not withstand the extreme and sudden heat without volatilization or combustion. Either of these caused the evolution of so much gas as to give a violent boiling effect with thermit and to dissipate the heat. It also seemed that any device based upon the M-14 grenade would be ineffective because thermate delivered less molten iron and less heat than thermit and because there seemed no simple way of providing a delay action to the Bouchon fuse. For these reasons it was decided in February to abandon the original problem as entirely impractical and to concentrate upon the development of a device which would make use of the properties of thermite, which recommend it, namely cutting and welding.

(b)(3) NatSecAct

From this point, [redacted] handled the problem entirely for the Division. Their first attempts were on pasteboard containers lined [redacted]

(b)(3) NatSecAct

A demonstration of these units on April 17, 1943, for representatives of CWS, OSS, and the British was run with complete success, a variety of metal machinery being effectively destroyed. As a result of this test the [redacted] (b)(3) NatSecAct Company proceeded to prepare 400 Wells for a more exhaustive study. These units were essentially as described above and very close to the final product. The standard pasteboard container with crimped metal ends had inserted in it the ceramic well. The bottom opening in the Well was covered not only with the metal strip mentioned above but also on the outside with a graphite sheet having a smaller orifice. The addition of this piece to the unit was required by the tendency of the molten material to erode the ceramic end giving a hole of variable size, thus greatly affecting the rate of discharge and thereby the performance. In the upper part of the Well, two ignition systems were provided consisting of lengths of Bickford safety fuse ending in sealed cellophane bags of an igniting mixture. It was planned that in shipment the fuse ends would be coiled underneath the metal snap cover of the cardboard container, where they would be readily accessible and yet protected until required.

By the end of May the 400 special thermit units of this design had been made and were supplied to MRL and SOE for evaluation. Elaborate tests showed that under favorable conditions of humidity the units were quite reliable in penetrating as much as one inch of mild steel. It was apparent, however, that in its present form the unit would not withstand exposure to tropical conditions, water vapor very easily penetrating the cardboard case and being preferentially absorbed by the first fire mixture with resultant failure to ignite. At the same time the Service liaison officers added a requirement of waterproofness. Accordingly, the [redacted] Company proceeded with attempts to meet these requirements by such methods as wax dipping and impregnation with tar. With the assistance of the manufacturers of the pasteboard container, a satisfactory water-tight unit was eventually developed.

(b)(3) NatSecAct

During July the British Mission was augmented in this country by the presence of Major W. M. Fox, and since the unit had been judged to be of value and use to SOE he became very active in assisting in the early production and in the development of a similar but smaller unit, the so-called Baby Well. A joint British, OSS, and NDRC procurement of 1000 units of both Wells was underway by August of 1943, and this preliminary production was of the greatest value in eliminating further faults which up to this time had been undetected. These were connected entirely with the ignition system which was still found to be erratic and susceptible to the changes in moisture.

In the development of the small unit, moreover, it was not found possible to use a pre-formed ceramic container because of space and weight limitations. This necessitated the development of a method of coating the inside of the cardboard outer container with a thickness of magnesite capable of withstanding the generated heat and at the same time having sufficient strength to survive rough usage. It will be recalled that this was an earlier type of the Large Well which had not been fully developed. However, by fall the small Well, aside from ignition trouble which was common to both Wells, was in condition for larger procurement.

(b)(6)

During December some 600 of the preliminary production of Large Wells reached MRL and there [redacted] undertook a detailed study of their performance characteristics. This resulted in a determination of the optimum standoff distance, the type of target on which the Well could be effective, methods for its use, and in a pointing up of the serious limitations in the ignition. The latter was successfully solved by joint work conducted by [redacted] and MRL. A new first fire mixture was developed, a new method of packaging it within the thermit charge was provided, and the Well emerged in form for final procurement.

(b)(3) NatSecAct

The accompanying illustrations of the Large Well will serve to show the unit as it was finally standardized, equipped with cardboard sleeve to provide a proper standoff from the target of about 1 inch. The Small Well, it will be noted, has no such cardboard sleeve and the standoff is achieved by a false bottom. Either unit can be ignited by strike igniters or by standard time Pencils.

Through very round-about channels in CWS a quantity of Wells reached the Armored Board at Fort Knox, Kentucky, in January of 1944 without explanation of how they were to be used or their purpose. Lacking this background, the Armored Board submitted in March of 1944 a report, No. 8067, which the Division felt was based on a misconception. Had the opportunity for a demonstration been given, it was felt that an unfortunate impression might have been corrected.

One last item remains in the history of the Well. This is the preparation by MRL of an instruction manual for it. Since a new weapon had been created and since its usefulness to an operator could not be very accurately conveyed by cold figures giving the penetration of different types of metal surfaces, it was decided to issue a book reproducing numbers of pictures of different types of standard machine tools, motors, generators, turbines, etc., each of these illustrations to be so marked that the user could locate the vital spot and effect the maximum possible damage. This decision was felt to be soundly based on previous British experience with untrained personnel and explosives. Without the benefit of such detailed instruction it had been found that most untutored operators tended to place their charges in ineffective locations, and training was found to be necessary before a man could be turned loose on his own in a large plant and in a minimum time with the minimum use of material accomplish the maximum damage. The booklets prepared by MRL formed the basis for such a course of instructions, and after this survey the value of the Well became very apparent. So great were its potentialities that it was felt to be a most dangerous weapon in the hands of improper persons, and it was estimated that the New York Edison plant, supplying power to the whole city, could be effectively put out of operation for several days by 20 minutes work and 24 wells properly placed. Several hundred copies of this manual were prepared and distributed to OSS and SOE during August and September of 1944.

In addition to being a useful weapon against the vital parts of machines, the Wells were found by MRL experiments to be exceedingly useful incendiaries

for attack on gasoline and oil dumps. This proved to be the chief value of the weapon in the long run, for in the Far East it was customary to have large numbers of gasoline drums stored in accessible and unprotected dumps. A Well properly placed beside such a drum and with a banking of earth to force the flowing metal against the drum could very easily accomplish its destruction and start a conflagration. It is in this use particularly that the Small Well excels, since it has sufficient charge to penetrate the relatively thin steel of the drum and yet is of a small size easily camouflaged. The original field of attack on heavy machinery still remains the chief value of the Large Well.

(b)(3) CIAAct
(b)(6)

[redacted] OSS, in July 1944, secured the cooperation of Edgewood Arsenal in developing a toxic modification of the Well to be used in the event that chemical warfare began. The work was entirely successful and was described in a special report dated 29 July 1944 on project E-7A-4. [redacted]

(b)(3) NatSecAct

In April of 1945 a further novel use of the Well was tested at Fort Belvoir by the Engineer Board. It was thought that perhaps this weapon could be used in "sealing the doors of enemy pillboxes to prevent infiltration and re-use by enemy snipers during battle movements." So promising did the Well appear that further work was carried on by the [redacted] (b)(3) NatSecAct Company directly with the Engineers.

Technical Information

[redacted]

(b)(3) NatSecAct

(b)(3) NatSecAct

[redacted]

As opposed to explosive which behaves in a more or less undirected manner and warps and distorts general structural shapes, the Well may be made to destroy or damage a particular device to which it is directed. Thus machined and cast shapes of complicated nature such as gears, bearings, etc., may be made useless and machines or apparatus containing large numbers of small, complicated parts are hopelessly ruined by the melting and flowing action of the hot steel slag. In addition, this type of munition makes it possible to get through protective steel cases up to 1 inch in thickness and thus to attack the vital parts of electrical control boxes, transmissions, electric motors and generators, water jackets, communications equipment, etc.

While the Well has been designed principally for cutting and melting, the function of welding must also be considered. If confinement of the molten iron released by the Well is provided, some welding can be on occasion accomplished, and this was the use contemplated by the Engineers in sealing steel doors of pill boxes. It is, however, entirely a secondary function.*

Problem Submitted: October 21, 1942. Problem Terminated: July 6, 1944.

Contract: The development was done without contract and without expense to the Government by the [redacted] Company under the direction of [redacted]

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct

Final Report: No final report has been submitted to [redacted]

(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded to [redacted] on June 14, 1944; included were specifications and drawings in application Serial No. 526,970 by Hirschland and Ricklin, "Alumino Thermic Units," filed March 17, 1944, and a royalty free license granted the Government.

(b)(3) CIAAct
(b)(6)

*This section is largely drawn from a memorandum prepared by [redacted] dated August 4, 1943.

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct

(b)(3) NatSecAct

Classification: Secret

SAC-9 CACCOLUBE

Operational Background

One of the first functions of guerillas and saboteurs is to interrupt enemy traffic and transportation, causing delays in distribution of goods and movement of personnel and if possible destruction of the transportation equipment. At the time when the problem was first posed, the German army was successfully operating deep in Russia, and it was said that if the Polish Underground could be supplied with methods of attack on automotive equipment they could seriously tie up the German supply lines which passed through Poland to the Russian front.

This was the immediate occasion for an investigation of the problem by the Director's Subcommittee, but it is obvious that if an answer could be obtained motor transportation everywhere in occupied territory would be a valuable and acceptable target. The fact that a satisfactory conclusion to the problem finally resulted too late for use by the Poles does not detract from the value that the information had to the over-all war picture.

It was known that automotive equipment in general was serviced by slave labor, who thus had access to the oil and fuel supplies or to the batteries and to all parts of the vehicle without arousing too much suspicion. It was important that any device placed in the hands of these willing servants must be of such a nature that it could be easily concealed on the person, be very effective in small quantities, and preferably leave no clue as to its origin. As will be seen below, these requirements were met with a considerable degree of success.

General Statement of the Problem

The requirement was to develop simple methods of treating gasoline, diesel oil, or lubricating oil to render internal combustion engines self-destructive. No limitation was placed upon any method of attack involving any part of the vehicle, and a number of ways of attack were looked into, chiefly by the British. The significant American work was restricted largely to attack on the oil and fuel supply.

Histo ical Background

This problem was discussed as early as July 1942 with Lt. Colonel Goodfellow, and at that time OSS was referred to the Office of the Chief of Chemical

Warfare, where information was believed to have been acquired by Lt. Colonel M. B. Chittick. On the formation of the Director's Subcommittee in October of that year, the problem became an active one for NDRC, and since Section B-9-A (later Section 11.2) had conducted a long research program on pro-knocks, the work of the Director's Subcommittee began with a resume of their previous findings.

(b)(3) NatSecAct

Two contracts had been begun by Division B in October 1942 with the [redacted] the object being to determine what concentrations of chemicals would be needed to sabotage "friendly" gasoline and also to determine what concentrations of chemicals would be required to produce destructive pro-knocks in automobile and airplane engines. By "friendly" gasoline was meant stores of gasoline which were likely to fall into enemy hands and which, because of their location underground, could not be fired before capture. It was thought that if some gasoline-soluble material could be found which on introduction into large tanks of gasoline would result later in the destruction of vehicles burning this gasoline, a valuable contribution would have resulted.

(b)(3) NatSecAct

[redacted]

(b)(3) NatSecAct

It was the recommendation of [redacted] in November 1942, at the time when he was Chief of Division 11, that [redacted] would be the best oil company to handle the study of fuel and lubricating additives. Accordingly, in December a meeting was arranged attended by representatives of NDRC, [redacted] OSS, and CWS. At that time, all previous information acquired from a number of sources was presented, including reports [redacted]

(b)(3) NatSecAct

From this conference and from numerous reports, a list of the most promising chemicals was compiled. This served as the basis for the start of work by [redacted] on a contract begun at that time in Division 11.2. The company began a systematic study of additives to the gasoline and oil supplies which eventually included over 250 different chemicals. The work was performed [redacted] using a variety of

(b)(3) NatSecAct

gasoline engines mounted on dynamometers and operating under controlled conditions. The behavior of these engines when supplied with contaminated gasoline and oil was easily followed by means of gauges and using this very elegant set-up it was possible [redacted] to eliminate a [redacted] (b)(3) NatSecAct number of compounds. The field was narrowed considerably by the desire to secure an active compound which would function satisfactorily in concentrations of the order of 0.1 percent and would result in destruction of the motor and not simply in rendering it inoperative for a short time.

The first success achieved was in July 1943, when it was found that the [redacted] (b)(3) NatSecAct

[redacted] One worker [redacted] was hospitalized for two wee (b)(3) NatSecAct lowing one of the experiments. It was hoped and believed that once the enemy had encountered this, engines having similar symptoms would be discarded.

A special report giving detailed directions for the use [redacted] (b)(3) NatSecAct [redacted] was issued at the request of OSS in May 1944 and was distributed at on (b)(3) NatSecAct [redacted] (b)(3) NatSecAct

Work continued actively along other lines and was rewarded in September of 1943 by a fortunate discovery. It was found that a constituent of [redacted] had remarkable results on (b)(3) NatSecAct the bearings when introduced as an impurity in the lubricating system. Th alloy appeared to have the ability to imbed itself in the soft bearing surfaces and actually to weld the bearing while in operation with resultant stripping of the bearing surface. There was at the same time considerable wear of the pistons in the cylinders. Although this was not as spectacular, it was of equal seriousness. An unsuspecting person driving an automobile so treated would be unaware that anything was seriously wrong with the car until after the greatest damage had been done. He would know only that the car appeared to lose power gradually, and he would eventually find himself with the accelerator pressed to the floorboard proceeding at a maximum speed of a few miles per hour. A motor in this condition requires a complete overhauling and rebuilding job, and it is generally considered cheaper to replace it with a new motor.

(b)(3) NatSecAct

[redacted]

As first proposed, the units of this sort, known as Turtle Eggs, were found on trial by OSS with very old automobiles to be ineffective. The reason for this discrepancy between field appraisal and the laboratory work was not apparent until examination of the bearings of these old cars indicated that the soft metal surfaces had become protected in the course of time by a hard enamel formed by oxidation of the lubricating oil. This enamel successfully protected the bearing surface from the destructive action of the alloy. Once this was known, in December of 1943 it was very easily corrected by the addition to the mixture of a small quantity [redacted] (b)(3) NatSecAct whose abrasive action wore away the protecting enamel and allowed the alloy ready access to the bearing surface.

Turtle Eggs of this kind were given a very thorough test when a group of six old cars of different designs were run over the roads around Beacon, New York, on December 27, 1943. These cars had been bought second-hand and put into running operation, but no attempt was made to prepare them for demonstration. Represented were: a 1937 Chevrolet, a 1936 Plymouth, a 1936 Ford V-8, a 1936 Packard, a 1935 Buick, and a 1935 Cadillac V-16. Each car was treated with one Turtle Egg and then run at a speed of not over 20 miles per hour. The road test was stopped when four of the cars were unable to run under their own power. While the Ford and Cadillac were still able to run, they were high on knocks and low on bearing oil; it appeared that they would eventually have failed.

Having thus demonstrated that the difficulty with old vehicles was overcome, it remained only to demonstrate that the Turtle Egg would be effective against military vehicles. Accordingly, on February 19, 1944, OSS arranged in cooperation with [redacted] (b)(3) NatSecAct for a test of two 1-1/2-ton Ford trucks, two similar Chevrolet trucks, and one 10-ton Mack diesel truck. Only one Ford and one Chevrolet were treated with Turtle Eggs; these failed after 44 miles and 188 miles of operation respectively. The Mack diesel ran considerably longer but eventually failed as well.

(b)(3) NatSecAct

At the request of OSS, [redacted] gave assistance to the Procurement Branch for the production of 30,000 Turtle Eggs. Through them specifications were prepared, a manufacturer was located [redacted] (b)(3) NatSecAct [redacted] and inspection procedures were set up with the result that an entirely satisfactory product was in the hands of OSS in quantity by May of 1944.

In addition to the two successful answers to the problem given above, the [redacted] rendered other services under the contract. They cooperated with [redacted] in arranging for tests of the Firefly (see SAC-21), they conferred with representatives of [redacted] (see SAC-25) on the sabotage of railroad equipment (SAC-10), and lastly they studied in some detail methods of sabotaging cutting fluids. This last subject suggested itself as a way of sabotaging machine shops where automatic screw machines and other automatic tools working at high speed are supplied with a continual flow of lubricating and cooling fluids. It was thought that the introduction of corrosive chemicals in small amounts in these fluids might escape detection for some time and by that time would have so corroded the machine itself as to damage it extensively and would so rust and pit the machine work that it would be valueless.

[redacted] was in an excellent position to know the value of traces of small quantities of impurities. A study by them of some fifty additives indicated that approximately ten substances [redacted] were effective in 0.1 percent concentration, inducing heavy rusting of the machine and the work and causing separation of the cutting oil which is generally used as an emulsion. Unfortunately, while this figure of 0.1 percent appeared good, it was not sufficiently so, since in large machine shops a common oil source supplies a number of machines and since these sources frequently contained as much as 10,000 gallons. Thus the quantity of additive required was beyond that which a saboteur could be expected to introduce without observation.

[redacted] This accidental discovery was passed on to OSS with the suggestion that [redacted] would lend itself to attack on locomotives and motor vehicles.

No work was done by the contractor specifically on airplane engines, since these were too difficult to come by for test; however, among the various automobile engines tested were engines quite comparable with airplane engines in construction, and there seemed no reason to doubt that Turtle Eggs and [redacted] would both be effective.

Some work was done with diesel engines at various times, but the problem of satisfactorily destroying the very crude, rough-and-ready diesel engines known to be used by the Japanese was felt to be insoluble; and while successful attack on German type diesels was more likely, depending upon the corrosion and plugging of the injectors, it was still not felt to have more than a nuisance value.

While the ideal solution to the Caccolube problem was not achieved, in that no material was found suitable for sabotaging large quantities of gasoline or oil, and while the diesel problem was not concluded to entire satisfaction, nevertheless two very workable solutions to the problem were obtained [redacted]

(b)(3) NatSecAct

Technical Information

[redacted]

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[redacted]

Problem Submitted: October 2, 1942. **Problem Terminated:** July 6, 1944.

(b)(3) NatSecAct

Contract: OEMsr-896 [redacted] January 15, 1943, to July 31, 1944; the contract was handled in Section 11.2 with [redacted] acting as Technical Aide; the funds for it, however, came out of Division 19's budget in the total amount of $48,000. (b)(3) CIAAct (b)(6)

Final Report: Division 19 Serial No. 15 in two parts, dated August 14, 1944: Part I, "Sabotage of Automotive Equipment," and Part II, "Sabotage of Cutting Fluids."

(b)(3) CIAAct (b)(6)

Patent Report: Invention report was forwarded [redacted] on September 6, 1944, and was entitled "Lubricating Oil Additive and Process."

Approved for Release: 2018/06/04 C02393825

[redacted]

(b)(3) NatSecAct

OFFICE OF SCIENTIFIC RESEARCH & DEVELOPMENT

HISTORY OF DIVISION 19

VOL. II OF III

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*149A FILE NO: CinCPac 4928 25 October 1944 - COMMANDER NIMITZ VISITS FAMOUS FATHER - Admiral C.W. Nimitz, USN Commander in Chief, U.S.Pacific Fleet and Pacific Ocean Areas, (left), gives a few pointers on small arms marksmanship to his son,Commander W.W.Nimitz,Jr., USN, at the Pacific Fleet Headquarters, while Lieutenant Commander H.A.Lamar, USNR (right) the Admiral's Flag Lieutenant, keeps an eye on the target. En route to new duties Commander Nimitz, who had command of a submarine in the Southwest Pacific for several patrols, recently visited his famous father at his Pacific Ocean Headqu...

 Secret to Confidential

SAC-10 CASEY JONES

Part I: General

Operational Background

The need for methods of attack against railroad traffic is obvious and requires no great explanation. The operational reports, however, served very clearly to indicate that the vulnerable spot in a railroad system is its locomotives. In occupied Europe this problem was very greatly accentuated, for there locomotives were under daily attack by the Air Forces. Moreover, they represented many types, since the Germans commandeered all equipment available in the whole of Europe and before many months had thoroughly mixed up the rolling stock with the result that damage to a locomotive was very serious, since suitable repair shops and spare parts were often many miles away. In addition to the general harassment which a continuing guerilla attack on railroad systems would have, there were the quasi-military operations which the underground was to undertake in conjunction with an Allied landing. Casey Jones was therefore one of the most important problems which the Division assumed.

General Statement of the Problem

The Division was asked to survey the field of existing equipment and to develop desirable devices for the disruption of railway transportation. It was pointed out that all enemy controlled rights-of-way were guarded at quarter mile intervals, so that a device must not involve a major operation such as planting in a roadbed. It was stated also that the enemy frequently ran a pilot train ahead of troop trains and ammunition trains to clear the track. It was hoped that the Division's work would produce a device which would overcome these counter measures.

Historical Background

(b)(3) CIAAct
(b)(6)

Prior to the establishment of the Director's Subcommittee there had been conversations on this subject and with the formalizing of the Division's activities, [redacted] assumed responsibility for the problem. He at once began conversations with various experts in railroading and proceeded to analyze data supplied by them and obtained from a number of [redacted] All the technical work was handled by him with the assistance of [redacted] During part of the time he was assisted

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(b)(3) CIAAct
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by [redacted], whose function it was to collect data on enemy railway systems and their equipment.

The various parts of the problem as they developed are discussed separately below. One contract was established to service the whole activity; this was with the [redacted] who provided the necessary materials and services for the rather extensive tests which were required. These tests in the main took place at Camp Claiborne, Louisiana, with the hearty cooperation and invaluable assistance of the various Railway Operating Battalions who were stationed there for training. Between June 1943 and April 1944 six different trials took place at Claiborne, chiefly on the Mole, the Fountain, and BRP.

In August 1944 other major trials were conducted at TVA (see SAC-49) on Mole and BRP. The assistance of Division 8 was secured through Dr. G. B. Kistiakowsky and advice on explosives was supplied by the Explosives Research Laboratory at Bruceton from time to time. OSS and SOE contributed as much operational information as was available and assigned active liaison officers to the program. At the same time OSS provided a large and expert photographic group who attended experiments and all major demonstrations and afterwards prepared instructional and informational films on Mole, Fountain, and BRP. These films were excellent documentary descriptions of the work accomplished and were of the greatest value for OSS training purposes.

In addition to the major subjects discussed below, a small amount of work was done also on perfection of the Fog Signal. This was a British track switch which provided initiation for their standard method of attack (see BRP). It had been put into American production in February 1944 and for a period was causing considerable trouble. The MRL testing facilities were used extensively by OSS procurement in straightening out the difficulties encountered. MRL participated also in experimentation of a device known as the "Land Mine Mark 35" which had been developed by the Navy for a special operation and was intended to cause derailments. This proved rather complicated and uncertain in its action. It also proved ineffective when tested at Camp Claiborne in April 1944; however, the vibration mechanism Mark 1 which it contained was shown by MRL to be a useful vibration fuse. OSS is not known to have made any use of the movements.

From the details given below the extent of the Division's work in this field will be apparent. With two of the devices (Mole and Fountain) no acceptable conclusion was reached and only a limited number of the former ever reached the field. However, the work done by the Division in the solution of the BRP problem justified all the activity, for the resulting information was passed immediately to the field and was used against the Germans with great success.

Contract: OEMsr-1173 with [redacted] official investigator; May 1, 1943, to December 31, 1944.

Final Report: Division 19 Serial No. 18 submitted to [redacted] on November 28, 1944.

Patent Report: Forwarded to [redacted] on December 5, 1944; no inventions were made.

Part II: Mole

Operational Background

Operational reports from the field made it clear that the vulnerable spots in a railroad system could be expected to be well guarded by the enemy, thus tunnels, curves, and bridges would in general not be accessible to a saboteur, and yet if a wreck could be produced at any of these spots the result would be unusually favorable.

(b)(3) CIAAct
(b)(6)

From the earliest conversations with railroad people and with SOE representatives, [redacted] concluded that a device which would accomplish a wreck in a tunnel was feasible and worth pursuing. This device, eventually known as Mole, was subject to the severe limitations imposed by practical use. It had to be a simple device easily operated, capable of withstanding shocks and rough treatment, [redacted] tain enough in its action [redacted]

(b)(3) NatSecAct

General Statement of the Problem

Two primary aspects became at once apparent: first, to determine the amount and location of adequately concealed self-borne explosive charges which would be sufficient to cause a train wreck, and second, to develop a device which would fire these charges after a pre-determined time delay on sudden transit from daylight to darkness.

(b)(3) CIAAct
(b)(6)

Historical Background

Following the first meeting of the Director's Subcommittee in October 1942, [redacted] commenced at once discussions with scientists at the [redacted] in Department 3540 working primarily for Division 4. He presented these men with the suggestion that [redacted]

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At the Director's Subcommittee meeting of December 1942, a preliminary sample [redacted] seemed so favorable that a contract with the [redacted], for its development was proposed and subsequently approved by NDRC. At that point, for reasons which are not clear, the [redacted] declined the contract. Later, as will be found under the discussion of the Sympathetic Fuze, the [redacted] (b)(3) NatSecAct [redacted] assumed the job of prime contractor and by subcontract with the [redacted] covered the expenditures incurred to date.

[redacted]

(b)(3) NatSecAct

(b)(3) CIAAct
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(b)(3) NatSecAct
(b)(3) NatSecAct

Numerous meetings on the whole problem of Casey Jones took place during the winter of 1943. At that time [redacted] urged that a device be developed which could be carried on a train and the [redacted] appeared to offer a solution. A prime contract was thereupon entered into with the [redacted] who proceeded during the period of August 1943 to February 1944 to carry the development of the second of the above types to completion. The result was the Mark I Mole.

(b)(3) CIAAct
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(b)(3) CIAAct
(b)(6)

[redacted] in his work with this device was greatly assisted by [redacted] Technical Aide in [redacted] office. Together they made contact with the Explosives Research Laboratory in Division 8 and proceeded to arrange trials which would answer the first part of the problem as originally stated, namely the question of proper location of the explosive charges on a train. In June 1943 [redacted] visited Camp Claiborne, Louisiana, and there with the assistance of the Army Transportation Corps ran experiments on European type freight cars (E cars) placed at his disposal through the [redacted] contract. These were not conclusive and were followed by further tests at Bruceton in August 1943. [redacted]

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The [redacted] people were in attendance at these demonstrations, and it was concluded that they should proceed to alter the circuit so as to provide a delay in the action of the fuse of approximately 10 seconds. This delay was calculated to give the train sufficient time to have traveled well into the tunnel, where the wreck would naturally be more serious. To accomplish this, the [redacted] required the use of the [redacted] through the cooperation of OSS, secured the release of these tubes, as well as the accompanying Ba-55 Minimax batteries.

(b)(3) NatSecAct

The delay type circuit was tested on the Lackawanna Railroad in a dry run in October, at which time it appeared that the unit fired erratically when [redacted] It also behaved poorly [redacted] Nevertheless, the Mark I Mole appeared close enough to perfection for a semi-production order, and OSS indicated their desire that 500 should be built. This order was, for a number of administrative reasons, placed by MRL on a firm selected by Dr. [redacted] which later became [redacted] and OSRD was later reimbursed by OSS, who provided the needed tubes and batteries and in addition a quantity of Alnico magnets (SAC-3) which were to be used to affix [redacted]

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(b)(3) NatSecAct

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(b)(6)
(b)(3) NatSecAct

In November a fourth visit to Camp Claiborne included in part a study of the attack by high explosives on the American type cars (A cars). These A cars were of a type common throughout occupied China and Manchuria and differed from the E cars materially. They proved much more of a problem from the explosive standpoint; in fact, no satisfactory way of using a reasonable explosive charge to accomplish their certain derailment was ever found. Nevertheless, the work continued, and because of the failure on the A cars, another visit was made [redacted] ran tests using [redacted] At that time it was thought that a charge of this type might be mounted on the under side of a flat car floor [redacted] This work was finally concluded with a full-scale trial at MRL on March 4, 1944 (see Report No. 61 of March 15, 1944), from which it appeared that this method of attack was likely to succeed. This was confirmed at the sixth Claiborne trial in April.

(b)(3) NatSecAct

By December 1, 1943, the first Mark I models prepared [redacted] (b)(3) CIAAct (b)(6) were ready for a dry run, which was made on the Lackawanna Railroad. The results were not entirely favorable, and at this time British criticism became audible, it being said that the time required to place the three parts of the Mole in darkness under emotional stress was too great. As the (b)(3) CIAAct (b)(6) [redacted] semi-production reached the final stage, it appeared that adequate assembly testing of it was desired, and since the Division had assumed responsibility for the order by virtue of the MRL placement, a (b)(3) NatSecAct contract was initiated with the [redacted] in New York to perform the necessary trials. These continued through April and May and it was found that on the whole under ambient conditions the Mark I Mole performed as expected. It was apparent, however, that it was not adequately waterproofed to withstand tropical conditions, and it was discovered that withdrawal of the arming pin on occasion resulted in an unwanted surge of electricity through the circuit and through the special blasting cap. While this unwanted current was never in practice sufficient to fire the cap, thus giving a premature, it was definitely not desired, and accordingly further changes in the circuit were felt necessary. For this purpose the Division entered into a prime contract with [redacted] for the construction of a small number of modified Moles later known as the Mark II. (b)(3) CIAAct (b)(6)

While this was going on, the Mark I production was completed and 463 Moles were delivered to OSS, who reimbursed NDRC for them and shipped most of them to the Italian and Yugoslavian theaters. The Mark II Mole appeared to meet the criticisms leveled at the Mark I, and OSS in the early part of August 1944 entered into a procurement contract with the [redacted] company for 1000 units. (b)(3) CIAAct (b)(6)

At the TVA trials in late August, the Mark I Moles and a few of the Mark II Moles were the subject of extensive experimentation, including a run with live explosive in a tunnel some 600 feet long which was there available. To the SOE and OSS liaison officers it appeared that the Mole was an unreliable device, being somewhat unpredictable in its function, and that because of the large weight of explosive probably required to derail an A car was not from the field point of view a desirable store. In addition, unfortunately a premature explosion occurred during the trials, and although there were no casualties this confirmed the adverse opinion which had been gaining ground in the Services. The result was their decision at a meeting on September 14, 1944, to withdraw from further Mole research and to cancel their outstanding order [redacted] This decision was brought about (b)(3) CIAAct (b)(6) in large measure by the satisfactory solution to the BRP problem. Had that problem not been solved it is very likely that the Services' decision on Mole would have been different.

With the withdrawal of OSS and SOE interest, [redacted] Dr. Chadwell (b)(3) CIAAct (b)(6) brought the device to the attention of the Army and Navy, but these contacts also came to nothing.

Meanwhile still further changes in the circuit were undertaken to prevent erratic firing at dawn and sunset. The result was the so-called Mark III

Mole, of which approximately ten samples were built [redacted] (b)(3) CIAAct
under the NDRC contract. Trials of these took place at NRL during May and (b)(6)
June 1945. The results were not unambiguous, and at this point the Mole
went underground for the last time.

Technical Information

These essential details of the Mole circuit are quoted from "A Summarizing Report on Project Casey Jones" prepared by [redacted] and dated September 1, 1945. (b)(3) CIAAct (b)(6)

1. The Mark I Mole.

[redacted] (b)(3) NatSecAct

2. The Mark II Mole.

[redacted] (b)(3) NatSecAct

3. The Mark III Mole.

[redacted] (b)(3) NatSecAct

Contracts: The original circuit: [redacted] (b)(3) NatSecAct, subcontract under Contract OEMsr-927 with [redacted] (b)(3) CIAAct [redacted] official investigator; concerned with this circuit between October 15, 1942, and February 10, 1943. (b)(3) CIAAct (b)(6) (b)(3) NatSecAct

The Mark I Mole: OEMsr-1238 with [redacted] (b)(6) (b)(3) NatSecAct [redacted], official investigator; August 15, 1943, to February 1. (b)(3) CIAAct (b)(6)

Testing of Mark I and Mark II Moles: OEMsr-1253 with [redacted] (b)(3) NatSecAct [redacted] official investigator; January 3, 1944, to February 28, 1945. (b)(3) CIAAct

The Mark II and Mark III Moles: OEMsr-1349 with [redacted] (b)(3) NatSecAct [redacted] official investigator; May 29, 1944, to March 31, 1945. (b)(3) NatSecAct (b)(6)

Final Reports: Subcontract under OEMsr-927 report entitled "The OSS-1 Job," dated February 10, 1943, by [redacted] of Department 3540. (b)(3) CIAAct (b)(6) (b)(3) NatSecAct

Division 19 Serial No. 9, OEMsr-1238, submitted to Dr. [redacted] on March 29, 1944. (b)(3) CIAAct (b)(6)

Division 19 Serial No. 27, OEMsr-1253, submitted to Dr. [redacted] on March 3, 1945.

Division 19 Serial No. 29, OEMsr-1349, submitted to Dr. [redacted] on March 31, 1945. (b)(3) CIAAct (b)(6)

Patent Reports: Subcontract under OEMsr-927: Serial No. 559,637 assigned to [redacted], and applied for by [redacted] (b)(3) NatSecAct (b)(3) CIAAct

OEMsr-1238: Serial 565,336 assigned to [redacted] [redacted] and applied for by [redacted] (b)(3) NatSecAct (b)(3) (b)(6) NatSecAct

OEMsr-1253: No inventions were made, as reported to Captain [redacted] on April 7, 1945. (b)(3) CIAAct (b)(6) (b)(6)

OEMsr-1349: Record of invention forwarded to Captain [redacted] on March 10, 1945.

Part III: Fountain

Operational Background

SOE in its extensive sabotage program against Continental railroads emphasized the importance of attacking locomotives. Presumably they were accomplishing this by their standard derailment procedure, for derailed locomotives represented a serious loss in equipment and time to the enemy. They were however also interested in other methods of attack, although putting on them the usual limitations of operational use which proved so difficult to meet. These included weight and size as well as simplicity and speed of installation.

General Statement of the Problem

In the memorandum dated August 5, 1943, a requirement was said to exist for a device which would damage a locomotive in a manner necessitating lengthy repairs. It was stated that the vulnerable points would be the cylinders and steam chest and the wheels. At the same time it was pointed out that attacks on cylinders or wheels conducted while the locomotive was stationary were not feasible because of limited opportunity and the great chance of premature discovery. This left a method of effecting the damage while the locomotive was in motion. Presumably the tree spigot (SAC-36) would be one answer, but it was stated that an anti-locomotive track mine would be preferable.

Historical Background

(b)(3) CIAAct
(b)(6)

[redacted] who handled the whole problem of Casey Jones for the Division, was assisted in this aspect of it [redacted] who acted as his Technical Aide throughout. The conception of Fountain as an anti-locomotive mine was very quickly arrived at, and on September 17, 1943, [redacted] in a letter to Mr. Lovell, sketched out the idea in its essential parts. He visualized a shaped charge to be planted on the outside of the rail in ballast and to be actuated by triggering device either mechanical or electrical which would operate on passage of either the first or some pre-selected subsequent wheel of the train. A feature of the assembly was a novel track switch to provide this initiation, and this was the subject of part of the [redacted] contract which was devoted primarily to the Mole (OEMsr-1238). Another part of the assembly consisted of a powder time delay varying at will between 15 and 60 milliseconds, a Picatinny Arsenal development under an informal arrangement.

(b)(3) CIAAct (b)(6)

(b)(3) CIAAct (b)(6)

(b)(3) NatSecAct

At the time, however, the chief requirements of the Fountain were the shaped charge and the electrical firing system. The former was designed jointly by Division 8 at the Bruceton Laboratory [redacted] (b)(3) NatSecAct at the Eastern Laboratory. In its final form it was a waterproof charge of pentolite having an 80° steel cone covered by a dummy head through which passed a primacord initiating strand.

The electrical parts of the system were more difficult to design. They were the responsibility of the [redacted] (b)(3) NatSecAct with whom Division 19 had a contract beginning in November 1943. Prior to this the rail switch of the [redacted] had been tested (b)(3) NatSecAct in the third tests run at Camp Claiborne in October. It appeared that a number of minor changes would be required, and these were subsequently made under the Federal Telephone contract.

At these same trials dummy locomotive cylinders were exposed to the action of a Fountain charge placed in a roadbed. The results appeared quite satisfactory. The first full disclosure of the Fountain and its various parts took place in December when at a conference at Picatinny Arsenal representatives of OSS, SOE [redacted] and NDRC were present. The (b)(3) NatSecAct device was demonstrated and did not behave entirely to the satisfaction of its designers. There was a division of opinion between SOE and OSS as to the practicability of the system. The OSS liaison officers (Major Sam Lucy, (b)(3) CIAAct (b)(6) [redacted] and Major J. M. Jeffries) were unanimously of the opinion that the Fountain as initiated by the electrical means was too complicated a device for the saboteur to use. They felt, however, that the shaped charge was excellent (if a little small) and that it could be satisfactorily used with the standard initiating device developed by the British and in American production, namely the Fog Signal.

As a result of this conference the over-all size of the chief part of the electrical system was reduced by some 40 percent. This unit was the counter, which had an adjustable dial by which an operator could select the wheel of the train (up to 10) which would initiate the charge. This counter was introduced to thwart any attempt at defense which the enemy might institute, such as pushing before the locomotive a dummy car or cars. The counter was not an essential part of the initiating system, since that could be accomplished on the first impulse by the use of the track switch and its accompanying electrical delay.

On January 15, 1944, large-scale tests took place at Aberdeen Proving Ground attended by all the interested parties. Again the track switch failed to function, tending to jam in the rail joint where it was inserted and to be crushed by movement of the rails. The counter also proved undependable, behaving most erratically. Nevertheless, successful shots were accomplished against the cylinders of a derelict locomotive and also against another locomotive under a full head of steam. Although in the latter case much steam escaped, the locomotive was still able to move under its own power and limp into the repair shop.

A final run was made in which the Fountain was planted between the rails and shot at the boiler of the locomotive. The results obtained were not too satisfactory, due probably to the long distance between the charge and the boiler. The OSS officers were reinforced in their previous decision about the Fountain and recommended that work should be abandoned on the electrical system and that the explosive charge should be increased from 4-inch to 6-inch diameter. The SOE liaison officers changed their previous opinion and felt that their agents would not have sufficient time or intelligence to install and operate so complicated a device. It was said also that the weight to be carried was excessive and the results to be expected were doubtful. Nevertheless, it was jointly concluded that work on the Fountain should continue, primarily on a simplified mechanical method of initiation, while the first priority of Casey Jones work would shift to BRP (to be discussed later).

(b)(3) CIAAct
(b)(6)

In March, at the fifth trial at Camp Claiborne, further Fountain shots were run with results not significantly different from those given above. [redacted] directed their attention toward the mechanical initiation and at the same time toward the procurement of 150 of the Fountain charges (Charge, Demolition, Fountain, T6). After long negotiations between Ordnance, NDRC, and OSS, the production of these charges was authorized [redacted] under Ordnance contract W-670 ORD-4331. At the same time Picatinny Arsenal was persuaded to work on the mechanical initiation system. In this work they were very closely directed by [redacted]

(b)(3) NatSecAct

(b)(3) CIAAct
(b)(6)

[redacted]

(b)(3) NatSecAct

On July 25, 1944, all these types were given a test on the Lackawanna Railroad. The result was not satisfactory, more than one-half of the Picatinny production of initiators failing to function.

A further request to Picatinny for 50 samples modified along certain lines was thereupon made. At the same test the electric counter was tested and failed to function. This was most disappointing because at the sixth trial at Camp Claiborne the electrical method of initiation had also failed to function on several occasions due to a number of explainable but unpredictable happenings.

After reviewing all this history on August 18, 1944, OSS informed Division 19 that "owing to difficulties experienced in developing and applying the mechanical initiator for the Fountain charge and in view of the present status of the war, we no longer desire you to do any work on this device

(b)(3) CIAAct (b)(6)

in our behalf." [redacted] felt that their decision in part had been reached because of doubts of the availability of suitably large track joints for the placement of mechanically or electrically run initiators. An analysis of this subject did not, however, change OSS opinion and thenceforth the Fountain was without a sponsor.

In late September it was brought to the attention of the Army and Navy groups, and in October further tests were run [redacted] on the Lackawanna. In these, two electrical switches were demonstrated to work most satisfactorily, but the mechanical detonators still were unreliable. (b)(3) CIAAct (b)(6)

Fountain charges which had been in storage at NRL were the subject of investigation there on their applicability to the Mole and Nemo problems. In the former it was shown that they were satisfactory for axle cutting, and in the latter it was shown that under water they behaved very well (see SAC-38).

Technical Information

[redacted]

(b)(3) NatSecAct

(b)(3) NatSecAct

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(b)(3) NatSecAct

[redacted]

[redacted]

(b)(3) NatSecAct

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)
(b)(3) NatSecAct

(b)(3) CIAAct
(b)(6)

Contracts: OEMsr-1238 with [redacted] official investigator; August 15, 1943, to February 1, 19
OEMsr-1215 with [redacted] official investigator; November 24, 1943, to December 31, 1944.

(b)(3) CIAAct
(b)(6)

(b)(3) CIAAct
(b)(6)

(b)(3) CIAAct
(b)(6)

Final Reports: Division 19 Serial No. 9, Part II, "Track Switch," of OEMsr-1238, submitted to [redacted] on March 29, 1944.
Division 19 Serial No. 36 of OEMsr-1215, submitted to [redacted] on October 2, 1945.

Patent Reports: No inventions were made under OEMsr-1238.
Report on OEMsr-1215 was not completed when this volume was prepared.

(b)(3) NatSecAct

CONFIDENTIAL

130416

(b)(3) NatSecAct

[redacted]

SECRET

Part IV: BRP

Operational Background

Throughout the war, SOE had instructed its agents on the Continent in a technique believed to be sufficient to cause satisfactory train wrecks. In this method [redacted] (b)(3) NatSecAct were assembled and carried by the agent to a track location. Attachment of this prepared set-up to the rail required only a few seconds and was generally done just prior to the arrival of a train. As the operational reports began to flow back from the field, doubt arose in the minds of the British on the effectiveness of this procedure and a careful analysis of nearly 100 attempted raids indicated that the percentage of derailment obtained was somewhere below 50. Since derailment operations were expected to precede and accompany D-Day, a solution to the problem became urgent, and a request was received from England that the larger facilities of this country be made available for experimentation.

General Statement of the Problem

Upon receipt, the problem was dubbed BURP (British Urgent Railway Problem) and was thenceforth known in more gentile circles as BRP. As originally outlined, it requested the determination of the length of single rail which would have to be removed to assure derailment of the locomotive. Secondly, it was required that the amount of explosive charge and the position of it to bring about this rail removal should be determined.

(b)(3) CIAAct (b)(6)

Historical Background

(b)(3) CIAAct (b)(6)

[redacted] upon receiving a statement of the problem, secured an introduction from [redacted] (b)(3) NatSecAct (b)(3) NatSecAct and from the files of that agency gathered data on derailments which had occurred over a period of many years in this country. His conclusion was that the slightest break in a rail would cause derailment in a high number of cases. With expert opinion from American railroaders and facts acquired from the ICC, doubt was expressed on the reliability of the British data. Nevertheless, it was decided that some experiments should be conducted. This was at the urgence of both OSS and SOE, who placed the highest priority upon the work.

In January 1944, Mr. D. P. McDougall at the Bruceton Laboratory of Division 8 performed preliminary experiments to determine the amount of PE necessary to break a 90-pound rail. His conclusion that [redacted] was sufficient (b)(3) NatSecAct

not allow a margin of safety but gave a clue to the amounts which should be used in the forthcoming experiments and indicated that the British [redacted] pound charges were of the correct order of magnitude. (b)(3) NatSecAct

In February, a detailed analysis of field reports was received from England together with the definition of derailment: "complete derailment of the locomotive and three or four of the leading cars." At the fifth Camp Claiborne trial in March 1944 the first attempt was made to solve the original British problem. A selection of straight track was made to provide the most unfavorable case and hopefully to give a solution which would be useful anywhere. [redacted] (b)(3) NatSecAct

OSS field photographic crews prepared a film of these experiments which was rushed to England, and the British comment urged further work along the lines suggested, together with the inclusion of experiments in bending, lifting, and breaking the rail. The result was a second trial at Camp Claiborne taking place in April. It was at once determined that the incredible length of [redacted] could be removed from a single rail without derailment, and since the amount of explosive required to remove this length of rail was greater than a man could carry conveniently, the original ERP problem appeared insoluble. (b)(3) NatSecAct

[redacted] (b)(3) NatSecAct When a locomotive running at 25 miles an hour hit this break in the track, it impaled itself on the receiving rail and presented a most satisfactory salvage problem for the 718th Railway Operating Battalion. It is interesting to note that this method of attack is not much different from that used by Lawrence of Arabia in the last war.

It appeared that ERP had been solved and the information was cabled to England at once, in time for use on D-Day. SOE in England continued for some months with attempts to bend rails at the time when they were broken, with the hope of creating an open switch which would be even more certain to cause derailment. This work came to naught, but it did serve to point

up an aspect of BRP which had been overlooked in this country. This was the effect of variation in type of roadbed ballast and in rail weight. Therefore, advantage was taken of the TVA experiments (SAC-49) to settle this point. Specially laid ballast and a variety of rail weights were the subject of BRP attack. The result was a modification of the technique recommended in May and distributed in OSS pamphlets in June and July. The new technique differed by an increase to 3 charges and was apparently sufficient to take care of any track situation.

Elaborate instructional films were prepared on all the BRP work and copies were supplied by OSS Field Photographic to SOE under high priority. Reports were later received from the British and OSS from time to time which indicated that the BRP technique achieved excellent results. It was not extensively used on D-Day because of the time lag in instruction of French agents. It was, however, most extensively used in Yugoslavia and Italy by OSS crews, and later in the Far East. On October 20, 1944, OSS and SOE indicated that they felt the problem had been satisfactorily solved and it was terminated.

Technical Information

The attached copy of the OSS booklet of July 1944 gives the original solution to the problem. The final solution based on TVA experiments is as follows: [redacted]

(b)(3) NatSecAct

Contract: None.

Final Report: MRL Report No. 151 of October 16, 1944.

(b)(3) NatSecAct

(b)(3) NatSecAct

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(b)(3) NatSecAct

[redacted]

Part V: Odometer and Speedometer

Odometer

Historical Background

(b)(3) CIAAct
(b)(6)

(b)(3) CIAAct
(b)(6)

The Odometer was a device first conceived by [redacted] of MRL, and based on the Veeder Root Counter, extensively used in industry. At the Division meeting of April 6, 1944, it was decided that a preliminary mechanical model should be constructed for Service appraisal. This was done in June and shown, after a successful demonstration on the Lackawanna Railroad. It was criticized by the user groups as being too large, and the suggestion was made that electrical ignition could be employed, thus materially reducing the complexity and size. In August at TVA the new design was demonstrated with successful results and placed in very limited OSS procurement.

Technical Information

"The Odometer is a device which initiates an explosion on a railroad car after it has traveled a [redacted] placing point. [redacted]

(b)(3) NatSecAct

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Contract: OEMsr-955 with [redacted] and [redacted] Investigators; May 15, 1943, to April 30, 1945.

(b)(3) CIAAct
(b)(6)

Final Report: MRL Report No. 194 of September 23, 1944.

Patent Report: Invention report forwarded to Captain [redacted] on April 11, 1945.

(b)(3) CIAAct
(b)(6)

Speedometer

Historical Background

On December 4, 1944, OSS requested the development of a [redacted] fuse. It was proposed to [redacted]

(b)(3) NatSecAct

The problem was solved within three months by an adaptation of the standard release mechanism A2 type 6. Trials of this device on the Lackawanna Railroad in April 1945 indicated it to be entirely satisfactory, and a very small production was undertaken by OSS.

Technical Information

[redacted]

(b)(3) NatSecAct

Contract: OEMsr-955 with [redacted]

(b)(3) CIAAct
(b)(6)

Final Reports: MRL Reports No. 164 dated December 5, 1944, and No. 199 dated April 27, 1945.

Patent Report: No inventions were made.

Approved for Release: 2018/06/04 C03126390

(b)(3) NatSecAct

Approved for Release: 2018/06/04 C03126390

Part VI: Sympathetic Fuse or Concussion Detonator

Operational Background

The British were carrying out extensive operations with Limpets in the harbors of occupied Europe and as a result felt the need of a simple device which would utilize the explosion of one Limpet charge to actuate a number of others located either on the same ship or on adjacent ships. In their operations they found that the value of using more than one Limpet increased exponentially. This lead them to the extreme procedure of connecting Limpets with long strands of primacord, an operation which was clumsy and dangerous to perform and which considerably prolonged the time required for an operator to make his attack. The demand existed for a simple fuse capable of initiation by the shock wave set up by the explosion [redacted] (b)(3) NatSecAct while at the same time being resistant to shocks and safe to handle.

As will be clear below, both the Army and the Navy had need of a similar fuse, although for entirely different operations; namely, beach demolitions and attack on underwater obstacles.

General Statement of the Problem

[redacted] (b)(3) NatSecAct

Historical Background

(b)(3) CIAAct
(b)(6)

A very involved contractual situation arose. [redacted], who assumed the responsibility for the program for the Division, proposed a contract with the (b)(3) NatSecAct [redacted] This was originally to include work on [redacted] and other relays. Under the term "other relays" was included the Sympathetic Fuse, and work on this was begun by the [redacted] (b)(3) NatSecAct early in February 1943, following closely after the start of their study on (b)(3) NatSecAct the [redacted] relay which eventually became the Mole. On the recommendation of the Director's Subcommittee, Section 17.2 requested and NDRC approved,

on January 15, 1943, a suitable contract with the [redacted] Inc., to finance these two problems.

Unfortunately, the [redacted] declined this contract (Symbol No. 2175) necessitating the naming of a new contractor, which [redacted] did in a letter to [redacted] on March 8, designating the [redacted]. In the following August, at the request of the [redacted] the starting date of the [redacted] contract was set back to October 1942, and a subcontract was approved between the [redacted] which covered expenses from the beginning and which was in effect to the end of the prime contract. This dual and complicated relationship existed throughout the life of the problem, and certainly is not to be recommended for repetition.

To revert to the technical history of the Sympathetic Fuze: [redacted] during February, informed the [redacted] groups of existing British work. This was based largely on a bulky fuze constructed on an inertia principle dependent for action upon the upsetting of a heavy weight balanced on a cone pin. This purely mechanical device was extremely erratic in fucntion and gave a maximum open range of only 70 feet. The principle on which it was based was almost immediately discarded, and the NDRC workers turned first to a design based on thin-walled glass chambers. This line of attack originated from the observation of one of the group that Christmas tree bulbs and other thin glass objects were readily crushed by an explosive wave in water. During February and March various modifications of this type were tried, and the interest of the Engineer Board was aroused.

At Dr. Chadwell's instigation, clearance was obtained for [redacted] representatives (chiefly [redacted]) to consult with the group under [redacted] then under Division 8. Using the facilities there and the good advice of that expert group, tests proceeded through the spring and resulted in the perfection of two models which received serious consideration in the underwater demolition studies of the Engineer Board at Fort Pierce, Florida.

Both modifications exposed a thin glass window to the explosive wave. In the first type shattering of the window immediately released the firing mechanism which was supported by it (HEP Model No. 1). In the other model (HEP Model No. 3) shattering of the window exposed to the action of the sea water a tablet of readily dissolved salt, which having dissolved permitted the firing of the fuze. The later model was so well thought of by the Engineer Board that [redacted] initiated production of 1000 units by the [redacted]

However, long before this production was completed, the fuze design underwent a radical change; this came about when in June and July a further series of tests showed that the frangible glass window could be replaced with a metal diaphragm of the bi-metallic type commonly used in thermostats. Such a diaphragm in the cocked position required a force of 9 pounds to snap it into the opposite position, where it released 45 pounds. This

energy was more than sufficient to accomplish the firing of a percussion cap and since metal had many properties superior to glass, entirely new fuzes were designed on this principle.

Several rather clumsy models were produced by September, and it was not until October 1943 that a model satisfactory in all respects was evolved. [redacted]

(b)(3) NatSecAct

This model, HEP No. 6, met with acceptance by both the Engineers and SOE, and at the same time became of interest to the DOLO Committee (Dr. H. E. Bragg) and the Navy Demolitions Unit (Lt. L. F. Porter). Because of the priority which the latter two groups had on NDRC Divisions, the contractor put aside the original SOE problem and proceeded to adapt the HEP No. 6 model to the requirements of the Army and Navy. This resulted in December in an order from the Engineer Board to the [redacted] for 120 units. These were the so-called high-pressure type model No. 66, had a [redacted]

(b)(3) NatSecAct

(b)(3) NatSecAct

This order reached a complete impasse, since SOE was dependent on OSS for procurement and OSS was reluctant to place the order or to determine their own requirements until the fuze had been exhaustively tested by MRL. Accordingly, during April and May MRL performed a number of substantiating [redacted]

(b)(3) NatSecAct

No further difficulty was experienced, except with the salt blocks which were used for arming the fuzes. In January 1945 MRL explored this

difficulty and in Report No. 189 of March 27 showed the great sensitiveness which this type of arming device has to water temperature and current velocity. Work continued there on low priority on ways to combat this, and Report No. 269 of August 10, 1945, gives their rather negative conclusions.

Division 19 was never informed in detail of the Army or Navy use of the No. 66 type fuze, although it was learned that the Engineers ordered 250,000 and that the Navy had comparably large requirements. Both Services rechristened the Sympathetic Fuze the Concussion Detonator T-1, and at last accounts were still using the device.

One other aspect requires attention. This was the application of the fuze to operation above water. It was hoped by SOE and OSS that air activation over a reasonable distance could be attained, since this would allow economy of time in preparing demolition attacks. No precise field requirement was ever stated. [redacted] at MRL received this problem in October 1944 and demonstrated that the Sympathetic Fuze can be used in this way if the [redacted]

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct

While the underwater Sympathetic Fuze did not meet the ideal requirements first defined by the British, it was, nevertheless, a most acceptable device and one which found large use in the Army and Navy. It is known that it was used as well in SOE and OSS operations.

Technical Information

[redacted]

(b)(3) NatSecAct

[redacted]

Contract: OEMSr-927 with [redacted] official investigator; October 1, 1942, to February 28, 1945.

Throughout the life of the contract, a subcontract existed with the [redacted]

Final Report: Division 19 Serial No. 23 was submitted to [redacted] on January 4, 1945. (Cf. Engineer Board Report 93395 of March 4, 1944.)

Patent Report: On March 8, 1945, final clearance of the patent report together with 43 listed inventions was forwarded by [redacted] to Captain [redacted] These included the Concussion Detonator, the Electrolytic Arming Disc, and the Mole.

(b)(3) NatSecAct

(b)(3) NatSecAct

Classification: Confidential

Part VI: Electrolytic Arming Disc

General Statement of the Problem

In the use of the Concussion Detonator and many other underwater devices it is vital for the protection of the user that delayed arming take place in a reliable manner. The conventional method of obtaining this is to use salt blocks, which are known to be extremely sensitive to humidity, to exposure, and, once immersed, to temperature differences and water turbulence.

In the SOE Sympathetic Fuze problem, conditions were not expected to be severe, since attack on vessels was made in harbors. Nevertheless, currents of several knots could be expected. In the Army and Navy use more serious conditions were encountered, for operations were carried out against obstacles close to shore where surf and currents were exceptionally bad. Their interest in an improved arming device was therefore apparent.

(b)(3) NatSecAct

Historical Background

The [redacted] had had considerable experience with the add-water type of sea cell (Division 6, NDRC), and it seemed likely that they could devise an Electrolytic Arming Disc based on this principle. At [redacted] suggestion their work began in September 1943.

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One hundred prototypes were supplied to the Engineers for test at Fort Pierce in March 1944, and so successfully did they function (cf. Report No. 811 on "Passage of Beach and Underwater Obstacles") that the Board set about the procurement of some 25,000.

This was not unattended with difficulty, and in January 1945 the Engineer Board appealed for assistance. An arrangement was sanctioned by the Chairman's Office whereby Section 6.1 contract OEMsr-1069 was used to reimburse the [redacted] for their consulting services. The result was the satisfactory production of a large number of these devices. The Navy followed the development throughout and is presumed to have participated in this production.

(b)(3) NatSecAct

Although the Electrolytic Arming Disc would have solved the difficulties of SOE, time did not permit their adoption of it.

Technical Information

[redacted]

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(b)(3) NatSecAct

[redacted]

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(b)(3) NatSecAct
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Contract: OEMsr-927 with [redacted] official investigator; October 1, 1942, to February 28, 1[redacted] Throughout the life of the contract, a subcontract existed with the [redacted]

(b)(3) CIAAct
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(b)(3) NatSecAct

Final Report: Division 19 Serial No. 23, Appendix D, entitled "Electrolytic Arming Cells," submitted to [redacted] on January 1, 1945.

(b)(3) CIAAct
(b)(6)

Patent Report: On March 8, 1945, final clearance of the patent report together with 43 listed inventions was forwarded by [redacted] Captain [redacted] These included the Concussion Detonator, the Electrolytic Arming Disc, and the Mole.

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(b)(3) CIAAct
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Approved for Release: 2018/06/04 C03126390

(b)(3) NatSecAct

CONFIDENTIAL

Classification: Confidential

SAC-11 WIRE

Operational Background

It was known to the membership of Section B-9-C that work done in Section B-9-B had resulted in the discovery of a water soluble wire having properties of electrical conductivity and workability suitable for relay application to a number of devices. It was suggested that this wire might be useful in connection with the initiation of Limpets, for its rate of solution in sea water had been determined and found to be quite insensitive to temperature change. SAC-11 is therefore a problem on time delay initiation using this special alloy. A certain overlap with SAC-17 was inevitable and resulted because of the late date at which the whole problem of time delays was submitted to NDRC. For a discussion of the needs of time delay devices, the reader is referred to SAC-17.

General Statement of the Problem

It was originally desired to develop a time delay for use in underwater devices which would be stable to the humidity of the atmosphere but would readily dissolve when exposed to sea water. Naturally the greatest reproducibility and the minimum temperature variance were sought for.

In the course of time it became apparent that the original purpose would not be fulfilled and the Wire was then considered as the basis of a number of different time delay systems which will be found described below.

Historical Background

Section B-9-B existed to handle a special and very secret Navy problem. One aspect of this problem, submitted by the Navy, involved the development of a wire having the electrical and tensile properties of copper but disintegrating in sea water. Such a wire used in a secret machine would result on immersion in the complete destruction of the wiring system of that device and prevent enemy salvage from securing a machine from which the elaborate mechanism could be reconstructed.

In May of 1942, Dr. Chadwell approached various groups who might offer suggestions. These included the [redacted] From these, several suggestions were forthcoming, of which the most promising was that presented by [redacted] He proposed the [redacted]

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[redacted]

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Experiments conducted in June by the [redacted] indicated that such wire was indeed very promising and that in 20-gauge would dissolve in sea water at room temperature in from 2 to 5 hours, while retaining 39 percent of the conductivity of copper. One drawback appeared in the difficulty of soldering and handling the somewhat brittle wire, and on June 18, 1942, it was decided by the Navy that this drawback was so serious that they could not accept the wire as a solution to the problem, while at the same time admitting that the chances of finding a better solution were very slim.

(b)(3) NatSecAct

Release of the information obtained was granted and Admiral J. A. Furer, Coordinator of Research and Development, authorized the disclosure of it specifically to various groups in the Signal Corps, Bureau of Ships, and Bureau of Aeronautics. From none of these contacts did any further use develop. Nevertheless, Section B-9-B thought so well of the idea that on its own initiative it continued work with the cooperation of the [redacted] During the same month the existence of the development was pointed out to other groups within NDRC, and samples of the wire were provided to a number of interested parties. Here also there was no further interest. Active direction of the work for the Committee had been in the hands of [redacted] and their final report of October 1942 indicated that it was possible to get a variety of times by changing the nature of the contaminating elements in the alloy, that these various alloys had suitable mechanical properties and could be adequately protected against atmospheric corrosion.

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At this point, although Section B-9-B continued in existence until the following January, the work on the alloy and applications of it was transferred to the newly formed Director's Subcommittee, and problem SAC-11 was submitted. It seemed to the group that it was important to round out the picture of the properties to be expected of the new alloy and its behavior in a manner which would be useful in devising a delay for Limpet operation.

(b)(3) NatSecAct

[redacted] continued its excellent cooperation, which was done entirely without contract, and during the next several months established by work in their laboratory a number of points such as the variation in time with thickness, the effect of annealing and hard rolling, the effect of salt concentration in sea water and of agitation, the effect of load on a dissolving member, etc. In all, a series of seven reports were submitted by the company in the period up to May 1943.

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Having established the basic behavior of the alloy, [redacted] group assumed the obligation of attempting to apply it to the specific problem of OSS. This was presented to them on November 2, 1942, and by January of 1943 a very compact mechanical firing device had been designed utilizing the wire in shear as a supporting member for a striker. At the end of that month the first models were shown to the OSS liaison officer, Captain Sam Lucy, and the suggestion was made that perhaps a design could be developed so that the wire might be the basis for a new time Pencil to compete with the standard Pencil then in production by OSS and the British and which at that time was encountering production difficulty.

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(b)(3) NatSecAct

It was during this period that the Director's Subcommittee was negotiating with the [redacted] a contract to handle the whole subject of time delay mechanisms (SAC-17) and as a preliminary to their work they were informed of a number of previous investigations, including the work done at the [redacted]. This so interested those at [redacted] that they expressed a willingness to undertake a complete investigation of the possibilities of developing a substitute Pencil. A cooperative program was initiated in March and the burden of the work was thereupon shifted to the [redacted] contributing sample sheets and wires of different alloy castings. By this time it had been decided that the original purpose proposed in connection with Limpetry would ~~my~~ be better met by the AC Delay, and accordingly work on that aspect ceased entirely.

(b)(3) NatSecAct
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In early May 1943 the Bat problem, already discussed under SAC-6, came to the fore, and [redacted] were requested to develop a 17-hour delay of the smallest possible dimensions and lightness. On July 1, this project was discontinued, since supposedly a firm decision had been reached that the Bat problem was not feasible for other than technical reasons. While the design proposed for the Bat problem had progressed somewhat and had not reached a final conclusion, it was not felt that the work had been in vain, for several other designs of time delays had been stimulated and prototype models constructed and tested. Some details of these will be found in the technical discussion.

(b)(3) NatSecAct

In most of these designs it was decided to rely on electrical initiation of high explosive rather than the more conventional mechanical type, and the release to the company of specifications and samples of the ND-24 cap produced by the [redacted] under Section T was secured.

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On October 22 [redacted] his assistant, called on [redacted] to revive the Bat problem and to lay down specifically the requirements for the delay which was to be used with the small incendiary unit to be carried by the Bats. In view of the previous work which had been done by [redacted] the construction of an entirely suitable delay meeting the new requirements was not a long process.

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By the first of February 1944 it had been demonstrated that a delay weighing less than five grams, including the magnesium igniter, could be made in lots of 100,000 for a few cents apiece and could be counted upon to give reliable operation at the specified time of approximately 22 hours without great susceptibility to temperature. In this delay, as in all models conceived and constructed after the abandonment of the Limpetry requirement, the electrolyte was provided in a glass ampoule and was changed from the original sea water to aqueous solutions of other common salts with ammonium chloride being preferred. It was extremely unfortunate that just as the X-ray time delay reached its perfection in March 1944 the Marine Corps and the Navy decided to abandon the project entirely because of reasons other than technical. It was felt that the latter had been adequately solved by the development of the Bat incendiary (SAC-6) and the X-ray delay based upon the wire.

While work on various designs continued for a short time, the coup de grace had been delivered and eventually it became clear that the wire could not compete with other time delay developments, and accordingly the project was closed on July 6, 1944.

<u>Technical Information</u>

(b)(3) NatSecAct

[redacted]

[redacted]

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(b)(3) NatSecAct

[redacted]

Problem Submitted: October 21, 1942. **Problem Terminated:** July 6, 1944.

Contracts: OEMsr-14 with the [redacted] official investigators; this contract was handled entirely under Section B-9-B and later Division 11 and is not properly a part of the History of Division 19. It is considered in the history of Section B-9-B, which is a separate document.

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OEMsr-876 with [redacted] official investigator; March 17, 1943, to July 15, 1945.

(b)(3) CIAAct (b)(3) NatSecAct (b)(6)

[redacted] donated its services and worked on the problem from May 1942 to July 1944; [redacted] was official investigator.

(b)(3) NatSecAct (b)(3) CIAAct (b)(6)

Final Report: OEMsr-14: Division B Serial No. 409 dated October 27, 1942; Division 19 Serial No. 31 dated July 15, 1945, of which Parts 3 and 4 are concerned with this subject (OEMsr-876).

Patent Report: No inventions were made.

(b)(3) NatSecAct

[redacted]

Approved for Release: 2018/06/04 C03126390

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SAC-13 PENETROMETER

Operational Background

The requirements for a silent, flashless weapon of short range have already been explained in the discussion of SAC-1. Three attempts to develop such a weapon for use in stalking sentries and for assassination were undertaken. Reference is invited to SAC-1 and SAC-14.

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[redacted] had suggested that hunting bows and arrows might be useful to Commando Forces, and the experience of [redacted] and his familiarity with these weapons was therefore tapped. "The qualifications which would recommend the hunting bow for the intended use would be that it is almost completely silent and that the hunting arrow properly designed and constructed is highly lethal because of its great penetration. It is literally a flying dagger with a double razor-sharp edge which strikes with energy many times greater than that of a hand-held dagger. The difficulties attending the successful use of the hunting bow, point definitely to some other means of storing and releasing the energy with which to achieve silent propulsion at sufficient speed of a penetrating missile.

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"These considerations led to the establishment of the premise that whatever the final development of the weapon, it must be so designed that energy may be kept stored within it for an indeterminate period before its release and subsequent conversion into kinetic energy of the missile. It should not be necessary for the user to impart energy to the device at the moment of shooting. He should be able to release the energy with the pull of a trigger. Other conditions laid down as a basis for the development were that the weapon should be readily portable and, if otherwise feasible, capable of concealment about the person."

Preliminary experiments and calculations suggested that rubber could be used in a device of the type contemplated with considerable promise of success.

General Statement of the Problem

The specific approach discussed here was based on the use of rubber under tension as a propellant of missiles and the requirements were not stated in more than general terms to include a maximum lethal accurate range, a minimum of sound, and a minimum of awkwardness. The latter point was expected to be especially important in this problem, since a cross-bow type of weapon was contemplated and it was not likely that such a weapon would be especially

useful in modern warfare where the users would have to transport it across rough terrain, presumably at night, and operate it under conditions requiring greatest security.

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A weapon of this general type had already received preliminary development by [redacted] and the problem as received from Mr. Lovell was based upon [redacted] existing work.

Historical Background

1. Penetrometer.

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As soon as the group in Section B-9-C had begun to function, Mr. Lovell, acting as Technical Aide, discussed the general problems submitted by the British with Dr. Karl T. Compton, who at that time was aware of [redacted] device. The result therefore was a demonstration of the device to [redacted] and Dr. Chadwell in October 1942, and at that time a contract to complete its development was suggested. With the establishment of the Director's Subcommittee, an existing contract in Section 3 of Division D with the [redacted] on which [redacted] was the technical representative, became available, and [redacted], a member of the Director's Subcommittee and Technical Aide of Division D, arranged for this contract to be used in part for this purpose.

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(b)(3) CIAAct
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(b)(3) NatSecAct

In December 1943 the Committee requested [redacted] to develop a rifle model and a pistol model but to put aside a grenade throwing mortar style model for the present. [redacted] felt that he had already surpassed the energy of a hunting bow with the pistol type model using high modulus rubber of high tensile strength and low hysteresis loss. He was well pleased with the silence achieved because of the efficiency of energy transfer from the rubber to the projectile. As events later developed, [redacted] under the [redacted] contract, limited his work entirely to the pistol type, which was dubbed Little Joe. The contract meanwhile passed to Division 17 upon reorganization of NDRC and in August 1943 to Division 19.

(b)(3) NatSecAct

Other types including variations of the pistol model and mortar design became the function of a separate contract which the Division initiated with [redacted] All the weapons had in common the use of stretched rubber as the propellant.

(b)(3) NatSecAct

The [redacted] contract was initiated by Division 17 in March 1943 and was transferred to Division 19 in May upon its establishment. In the interest of clarity, the discussion below will be taken up by separate contracts.

(b)(3) NatSecAct

a. The [redacted] Contract.

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Since this was concerned with [redacted] partially developed pistol model, it was more advanced than the other work, and a model shown early in 1943 excited sufficient interest from the British liaison officers so that the Division requested in June of that year 50 Little Joe devices to be fabricated together with approximately 1000 darts.

(b)(3) NatSecAct

In the following months this work was carried on with subcontractors. [redacted] Dies were made and semi-production units of reinforced aluminum were constructed. Twenty-seven of these were fully assembled and of this number four were dispatched to England at the request of [redacted] nine were sent to MRL for the use of OSS, twelve were provided to Army Ordnance for field evaluation, and two were retained by [redacted] for further work.

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As a result of Dr. Karl T. Compton's tour of the Southwest Pacific in January 1944, a request was received by cable from General MacArthur's Headquarters for samples of Little Joe and other models developed by Northwestern. This request originated with General Akin and the Alamo Scouts, located at that time on Goodenough Island. This unit of scouts was used extensively through the campaign for the gathering of intelligence in advance of amphibious landings. The weapons were thought to be of value to them in shooting game without attracting enemy notice and on occasion for the assassination of sentries. The units requested were provided to Army Ordnance, in March 1944, and were shipped by Colonel R. R. Studler, who had been named liaison officer on the problem. Trials in the field did not result in acceptance of the device, and upon the return of [redacted] from an extended stay in that area, the contract was terminated in December 1944.

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(b)(3) NatSecAct

b. [redacted] Contract.

To fulfill the OSS interest in rifle models and to explore the possibilities with a mortar type capable of throwing a hand grenade or a mortar shell, a separate contract was initiated as mentioned above with [redacted] in March 1943. A preliminary study conducted by the Central Scientific group with the cooperation of the [redacted] proved a fortunate forerunner of the University's work.

(b)(3) NatSecAct

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Work under this contract eventually resulted by the following February in the construction of 15 laboratory models, from which 4 were finally selected as being more suitable. These 4 were: Little Joe Pedal 1, a pistol type; Big Joe 5 and Big Joe 6, rifle types, one of them capable of throwing flares; and E5, a mortar type. Samples of all of these were requested by General MacArthur at that time, and since no

production had been contemplated or begun the cooperation of the Engineering and Transition Office was solicited to find a subcontractor who could produce the desired models.

In February 1944, that office recommended the [redacted] (b)(3) NatSecAct [redacted] (b)(3) NatSecAct a subsidiary of [redacted] and agreements were made for the production of 42 units of the four different types specified above. During the course of the work, the E5 unit was dropped because of its poor performance, but other types were delivered to [redacted] (b)(3) NatSecAct by the contractor in August 1944 and were taken to the Pacific for field appraisal under the auspices of the Office of Field Service by [redacted] (b)(3) CIAAct (b)(6) who had been associated with the [redacted] (b)(3) NatSecAct contract from its beginning.

[redacted] (b)(3) CIAAct (b)(6) took with him at the same time samples of the Spigot and the silenced guns, and all were demonstrated at various points before a number of Service groups. The same fate which met Little Joe was experienced here as well. The devices received a variable reception, which on the whole was not favorable, and further requests for production were not forthcoming. In view of this, the [redacted] (b)(3) NatSecAct [redacted] (b)(3) NatSecAct contract was allowed to expire on October 1, 1944.

c. [redacted] (b)(3) NatSecAct

The Engineering and Transition Office, very soon after its recommendation of the [redacted] (b)(3) NatSecAct as a subcontractor for the production of Chinese copies of the Northwestern design, proposed that a prime contract between Division 19 and New Products be arranged. This would cover production, engineering, and a redesign of the rifle type exemplified by BJ-5 and BJ-6. The Division felt that it was advisable to do this in view of the possible future production demands which might result from the visit of [redacted] (b)(3) CIAAct (b)(6) to the Pacific.

Accordingly, a separate contract was begun on March 1, 1944, and this resulted in the development of a rifle model known as William Tell based on all the work done by the [redacted] (b)(3) NatSecAct contracts, but with such design changes as were felt necessary to make the units easily producible. At the request of the Division 4 models of William Tell were produced for field appraisal, and in the course of time these received the following distribution: in November 1944 one was sent to India at the request of Colonel A. Whiteside of the British General Staff; in November 1944 one was sent to Aberdeen Proving Ground at the request of Army Ordnance; in January 1945 one was sent to ISRB in England at the request of [redacted] (b)(3) CIAAct (b)(6); and in April 1945 one was sent to [redacted], OSRD liaison officer with the Airborne Command in ETO. All these requests, except the last, resulted from an NRL demonstration of all types of silent weapons which was arranged for the benefit of the Army Ground Forces on January 21, 1944.

As in the other two cases, the William Tell failed to arouse an active theater demand, and production was never undertaken.

In January and February of 1945 the William Tell received very vigorous user trials at MRL with the cooperation of OSS and passed these trials with an excellent record. It appeared therefore that the original request of OSS for a rifle model of this type had been fulfilled satisfactorily by the William Tell and that their request and the original British request for the pistol type had been satisfied technically by Little Joe.

Although frequent items appeared in the public press indicating that cross-bows and other medieval weapons of the Penetrometer type were used from time to time, the Services never felt justified in providing the units for the field. The usual attitude was to consider Penetrometers as curiosities, while at the same time admitting that they had great penetrating power, silence, and flashlessness. The numerous attempts made by the Division to bring about Service acceptance came to naught, and it was doubtful whether large production could ever have taken place, inasmuch as the only rubber propellant found which had the desired qualities was based on natural rubber, a material which would have been most difficult to secure.

2. SAC-13B - Bigot.

In the fall of 1944, a very interesting proposal was made by Mr. B. R. Binyon of MRL for a weapon which might fulfill the operational requirement stated above. He proposed that the principle of the Spigot Mortar (SAC-36) be applied to the .45 caliber Army pistol, which was a standard weapon.

It appeared likely that a steel arrow might be fired with accuracy and force using a simple accessory and without flash or noise. This suggestion aroused the interest of the Engineering and Transition Office and early in December 1944, after the New Products contract had completed the construction of the four William Tells, it was decided to ask them to construct Bigot models so that the idea might be tested.

Their work during January 1945 served to show that the idea was practical and that an effective weapon might result. A demonstration took place at MRL on January 30 with OSS, MRL, and OSRD representatives present. It appeared that the chief difficulty lay in tumbling of the projectile in flight and attempts to correct this occupied the attention of the contractor and the Transition Office representatives,

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[redacted], throughout the following months.

In this effort they were assisted by personnel from Division I, Division 3, and the Bureau of Standards. This resulted in a finalized design, of which 300 were made by the [redacted] together with 25 of the accessory spigots.

(b)(3) NatSecAct

At this point in the development, it was decided advisable to secure the criticism and evaluation of Army Ground Forces and Ordnance, and on July 13 a joint meeting of all the interested parties was called, at which time it was decided that the Engineering and Transition Office would continue the development of the device on its own responsibility and that samples would eventually be forthcoming for Army Ground Force and Ordnance appraisal. The Division therefore did not succeed in bringing the Bigot to a stage of complete development before the termination of its activities. It was learned later that OSS independently demonstrated in a small way with some success a design in which a collapsable Spigot was an integral part of the projectile.

Technical Information

1. The Central Scientific Little Joe

(b)(3) NatSecAct

[redacted] The unit weighs about [redacted] 1/4 lbs, measures 13x8x2 in., has an accurate lethal range of 30 yds. and an extreme range of 250 yds., uses an arrow weighing 0.8 oz., and imparts a velocity of approximately 170 ft/sec.

2. [redacted] Weapons. (b)(3) NatSecAct

a. Little Joe Pedal - LJP-1.

This unit weighs 3.1 lbs., is collapsible, and is cocked by a pedal action. It is capable of throwing a dart weighing 24 g. with a velocity

of 170 ft/sec. over a maximum range of 700 ft., although its lethal range is not beyond 240 ft. Its penetration at 6 ft. is 12 in. in solid horse meat or 1-2/10 in. in fir. The energy stored in the rubber is 160 lbs.

b. <u>Big Joe 5 - BJ-5.</u>

This rifle type unit weighs 9.4 lbs., is also collapsible, and throws a projectile of the flare type weighing 140 g. with a velocity of 140 ft/sec. over a maximum range of 600 ft. The energy stored in the rubber in this case is 550 lbs. The penetration is 8 in. of horse meat or 1.5 in. of wood (fir).

c. <u>Big Joe 6 - BJ-6.</u>

This rifle type unit weighs 5.8 g., is collapsible, throws a dart weighing 44 g. at 250 ft/sec. a maximum distance of 950 ft. The estimated lethal range is 150 yds. and the penetration is the same as BJ-5.

d. <u>Joe Louis.</u>

This is a collapsible mortar type weapon capable of throwing the standard rifle grenade at 40 ft/sec. over a maximum range of 800 ft. The pull on the rubber is 1200 lbs.

The chief obstacle to the development and use of these weapons lay in the difficulty of putting the required energy into the rubber easily and quickly and of releasing this energy instantly when the trigger was pulled. [redacted]

(b)(3) NatSecAct

3. [redacted] <u>Weapons.</u>

(b)(3) NatSecAct

a. <u>William Tell.</u>

This weapon is based on the original experimental design of Little Joe Pedal 1. In its final form it consists of a rubber powered crossbow firing a steel tipped dart at approximately 180 ft/sec. It weighs 3.3 lbs., has a trigger pull of 4 to 6 lbs., [redacted] .8 oz. [redacted]

(b)(3) NatSecAct

b. <u>Bigot.</u>

[redacted]

(b)(3) NatSecAct

[redacted]

(b)(3) NatSecAct

Problem Submitted: October 21, 1942. **Problem Terminated:** June 30, 1945.

Contracts: OEMsr-577 with [redacted] official investigators; June 1, 1942, t December 31, 1944;
OEMsr-924 with [redacted] official investigator; March 1, 1943, to September 1, 1944;
OEMsr-1341 with the [redacted] official investigator; March 1, 1944, to June 30, 1945.

(b)(3) CIAAct (b)(3) NatSecAct (b)(6)

Final Reports: Division 19 Serial No. 25, OEMsr-577, sent to [redacted] February 16, 1945; Serial No. 17, OEMsr-924, in two parts, sent to Dr. [redacted] November 20, 1944; Serial No. 33, OEMsr-1341, in two parts, sent t[redacted] October 10, 1945.

(b)(3) CIAAct (b)(6)

Patent Reports: OEMsr-577, report forwarded to Captain [redacted] on December 7, 1943; OEMsr-924, report forwarded to Captain [redacted] on July 7, 1945; OEMsr-1341, report not completed when this volume was prepared.

(b)(3) CIAAct (b)(6)

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(b)(3) NatSecAct

[redacted]

Classification: Confidential

SAC-14 SILENCER

Operational Background

It will be recalled that problems SAC-1, SAC-13, and SAC-14 complete a trio of problems, of which this is the last member, dealing with silent, flashless weapons for close range work. It does not seem necessary to go into the operational requirements further in this case, since they are identical with those already stated in the other two problems.

General Statement of the Problem

The most obvious approach to the problem of short range, silent assassination lies in the use of existing fire arms which have been suitably altered to meet the special case. The application of Silencers to pistols is of course not new, and the so-called "Maxim Silencer" developed many years before the present war is just one example of a number of attempts at solution. It happens to have been widely publicised by writers of the type of E. Phillips Oppenheim.

While this past knowledge was known and available, the feeling existed that the ultimate had not been reached, and it was certainly clear that standard weapons of present-day manufacture had not received attention of this kind in America. ISRB in England had for some time been working on the problem and, as a matter of fact, had very good solutions for British weapons, notably the .22 Pistol and the Sten Gun. They had also at [redacted] est- (b)(3) NatSecAct lished a rather large machine shop for the purpose of carrying out research and small scale production of a number of other silent weapons. From this group a notable silent gun was forthcoming, namely the Welrod, mention of which will be made below.

In spite of this large program underway in England, OSS felt it desirable that an independent study be undertaken on silencing a number of guns available in this country, and the request was made that NDRC investigate various calibers of single-shot and semi-automatic fire arms with the object of eliminating both sound and flash. It was hoped that sound reduction would be sufficient in amount or character to make location of the fire arm uncertain to an observer.

Historical Background

Since the work involved sound measurement and control and might be expect- to yield to acoustic filters, the [redacted] was selected a (b)(3) NatSecAct

a contractor and work began in the [redacted] in January (b)(3) NatSecAct 1943 as the result of a contract proposal submitted by Division 17 at the request of the Director's Subcommittee. In the following May this contract was transferred to Division 19, where it remained until its termination.

Mr. S. P. Lovell of OSS arranged a conference between the contractor's representatives and Colonel R. R. Studler, an expert in small arms in Army Ordnance. Colonel Studler was most helpful in bringing to the contractor silenced weapons in his possession and a considerable number of pertinent publications and reports. A fairly close liaison existed throughout the life of the problem between Division 19, its contractor, OSS, and Colonel Studler's office.

This resulted on July 7, 1943, in a test conducted under the Colonel's direction at Aberdeen Proving Ground, at which time a comparison was made of silenced weapons including the following: .30 caliber carbine, .45 caliber M-3 Submachine Gun, .45 caliber single-shot pistol, .22 caliber automatic pistol, and British .22 automatic pistol known as the Welsilencer. It was the conclusion of the Ordnance Department in a report of 28 July 1943 (Project 4972) that silencers were "unsuitable for ordinary military use" because of their bulkiness and because they did not in the opinion of the officers present succeed in altering the sound so that identification of it as to nature and location was impossible.

On July 8, 1943, these same weapons were demonstrated more completely at MRL and sound measurements were taken which indicated that on the average it was possible to cut the sound level by about 35 d.b. (30 percent). These preliminary trials were followed in September by a further trial in which the Silenced .22 was demonstrated to arouse little suspicion when fired repeatedly at a distance of 50 yards from a large group of people.

It was generally concluded that a silenced gun of this type would be effective for use in OSS and SOE operations. While admittedly it would not satisfy the regular Army, part of the value to OSS would lie in the fact that only one or two shots were expected to be fired, and at that time it was not felt necessary to silence effectively a semi-automatic gun.

At the end of September large-scale trials were conducted at MRL in which the whole arsenal of weapons was shown to representatives of the British Army, the Marine Corps, Army Ordnance, the Bureau of Ordnance, OSS, and NDRC. A full comparison was made with the British weapons which had been developed in England and sound measurements were made. The Marine Corps and the Bureau of Ordnance in the following month became much interested in the Welrod and were understood to have requested a limited procurement in England and to have laid plans for further procurement in this country. The .22 pistol appealed to the operating groups in OSS, and as a result the contractor was called upon to provide 65 silenced weapons of this type for OSS field appraisal. This was done in November of 1943, and at the same time the contractor acted as consultant to the [redacted] (b)(3) NatSecAct [redacted] who had been selected by OSS as manufacturer for subsequent orders.

These orders in the course of time came to several thousand units, and the .22 pistol found its place among the standard OSS devices and was very well received by the field.

During the latter part of this period, the contractor had turned his attention more completely to attempts to silence the M-3 automatic, of which Colonel Studler was the originator and which was a standard Army store. A full report of this subject appeared on November 15, 1943, and by the following February six samples had been delivered to OSS and one to Colonel Studler. The latter was tested at Aberdeen in March and measured up well against the competitive samples provided by direct Ordnance contracts with other companies.

(b)(3) NatSecAct

In April 1944 OSS entered into a further contract with the [redacted] for the silencing of 1000 of these submachine guns, and so well were the weapons received in the field that further requirements for 4000 more resulted. At that time, however, it was not clear whether Army Ordnance would release to the contractor the necessary barrels for silencing, and accordingly OSS requested that NDRC determine whether the M1A1 Thompson Submachine Gun could also be silenced to a comparable degree. It was thought that there would be no difficulty in procurement of this particular gun, and it was known that it was of interest to the Marine Corps. The contractor was successful in accomplishing this new task, and a satisfactory demonstration of the Silenced M1A1 took place at MRL on December 27, 1944. Complete drawings of the unit were purchased by MRL and were passed on by OSS in January 1945 to the Marine Corps. By that time, however, the barrels required for the M3 production had been released, and the silenced M1A1 was therefore not produced.

Throughout the last part of the contract, attempts were made to silence the .30 caliber Carbine, since a desire for such a weapon had been expressed in a cable from General MacArthur to Colonel Studler and also because the Carbine was a standard weapon of wide distribution. From theoretical reasons that will be stated below it was clear that the carbine could not be silenced effectively so long as its muzzle velocity remained above 1000 feet per second. In general, the Services were not willing to lower it to this value, and accordingly all that could be claimed as a result of this work was given in a report on June 9, 1944, on "Flash Reduction on Carbines."

The flash reducers described in this report were requested for trial by Army Ground Forces, and samples were dispatched to Fort Benning on July 19, 1944, where samples of the M3 and .22 had previously been sent. The general reaction from these trials by the Infantry Board was that the .22 was inadequate as a military weapon in striking power and that the effectiveness of the Silencer on the M3 and the flash reducer of the Carbine were not sufficient to overcome the deficiencies of added weight, clumsiness, etc. A report by the Infantry Board (No. 1731) submitted on 5 December 1944 illustrates the point of view taken by Army Ground Forces on weapons of this type.

During the summer of 1944, as stated in the discussion of SAC-13, an Office of Field Service representative, [redacted] traveled to the South Pacific area with samples of the Penetrometer at the request of the Alamo Scouts. He took with him at that time and demonstrated the Hi-Standard Silenced .22, then in production by OSS, and a laboratory model of a silenced .22 rifle. While the weapons were judged of possible value in hunting game in the jungle close to enemy lines and while eventually nearly a dozen weapons of this type found their way into the hands of the Scouts, no large demand resulted. Instead, more interest was expressed in the Silenced M3, and in September 1944 a formal request for 50 of these reached Division 19 through OFS and was passed on to OSS for fulfillment by special air priority. It is interesting to note that the comments obtained by [redacted] in the field indicated a greater interest in a silenced .45 and/or .38 caliber weapon, the feeling being expressed that the .22 was too light for effective use. This latter point was in dispute for the .22 has excellent penetrative power at close range and is considered lethal in the hands of a good marksman. It was felt that the field interest in the .45 could be most satisfactorily solved by Bigot, already described in SAC-13.

(b)(3) CIAAct
(b)(6)

Throughout the two and one-half years of activity in this problem, the Division and OSS made every attempt to bring its products to the attention of all interested parties in the regular Services. Had OSS not gone into fairly large production on the .22 and the M3, the other Services would have suffered, in the opinion of the writer. Since their special group requirements for weapons of this type never seemed sufficient in importance or number to bring about standard Army or Navy procurement. Many small requests of special missions for unusual weapons of this type could best be filled by an agency such as OSS, and in this particular problem their functioning along such lines is illustrative of the value of the more unorthrodox and liberal minded attitude which OSS could afford to and did show. It is safe to say also that the independent work which was undertaken in this country was in no sense a waste, in spite of the rather extensive developments which the British had made in the field. In addition to providing experimental models and proving the feasibility of silencing a number of standard American guns, the contractor also in his final report presented an excellent summary of the theory behind silencing, a study which had been needed by the Services.

Technical Information

It appeared at once that there are three primary sound sources in a weapon of this type: the mechanism itself, ballistic noise of the bullet traveling through air, and the muzzle blast caused by the release of gases after the bullet leaves the gun. The British Welrod is probably the closest solution to all three of these problems. Being a completely new gun, the mechanism is designed and built to be as silent in its operation as possible; the velocity of the bullet has been dropped below that of sound, thereby effectively cutting the ballistic noise; and the barrel of the gun has been provided with a suitable silencer to seal in and prevent the sudden release

of hot gas which produces the muzzle blast. Unfortunately the Welrod requires two hands for effective operation and is a single-shot weapon unsuitable for quick reloading and firing.

The work done in America concerned itself only with the last of the three sources of sound, namely the muzzle blast. It was not felt advisable to design a new weapon such as the Welrod with silent mechanical operation, and it was recognized that it is probably impossible to control effectively the ballistic noise of a projectile traveling with a speed greater than that of sound.

(b)(3) NatSecAct

[redacted]

In addition, it was demonstrated that if a silencer is accurately made and properly aligned with the muzzle of the gun, no adverse effect on accuracy or dispersion results. On both the .22 and the M3 there is sufficient barrel length to secure a major reduction in noise by alteration of the barrel, and to complete the reduction by a screen disc silencer built on the muzzle.

Since it was recognized that the ballistic noise due to the bullet cannot be controlled if the bullet is traveling at a speed greater than that of sound, it was found most feasible to operate with weapons whose muzzle velocity approached 950 ft/sec. but did not greatly exceed that value. This necessarily results in the reduction of bullet speed in a number of cases and therefore in the energy which such a bullet can deliver on striking a target. This inter-relationship between velocity, ballistic noise, and penetration, was the subject of some study. Attempts were made to use a special munition which would compensate for the energy lost by having greater mass, and these resulted in complete success from the theoretical point of view. Unfortunately, the special heavy ammunition was not desired by the users because of supply difficulties in the field. Also, it was found that projectiles of this type yawed badly.

Considerations of the kind mentioned above resulted in successful designs for silencers for the M3, the .22, and the M1A1. The same principles led also to a successful flash-reducer of the same general type for use with the high velocity .30 caliber Carbine. In this case, however, the velocity of the bullet was not appreciably reduced and the ballistic sound was therefore unaffected.

Silencers of the above type are found to be remarkably permanent and if properly cleaned and kept can be fired with undiminished effectiveness for hundreds of rounds.

Problem Submitted: November 12, 1942. Problem Terminated: March 13, 1945.

Contract: OEMsr-906 with the [redacted] (b)(3) CIAAct
[redacted] official (b)(3) NatSecAct
investigators; December 1, 1942, to December 31, 1944. (b)(6)

Final Report: Division 19 Serial No. 11; Part I submitted to [redacted] (b)(3) CIAAct
on February 18, 1944; Part II, June 19, 1944. (b)(6)

Patent Report: Patent applications were forwarded to Captain [redacted] (b)(3) CIAAct
on June 27, 1944 (Serial No. 534,259), and on December 4, 1944 (Serial No. 560,456, No. 560,457, and No. 560,458). (b)(6)

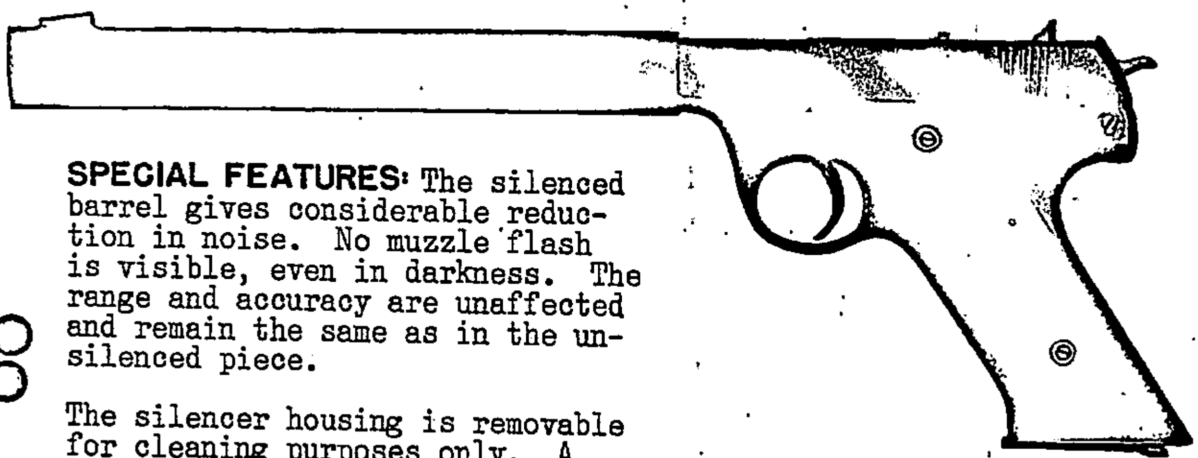
RESTRICTED

SILENCED .22 CALIBER
AUTOMATIC PISTOL
PART I - SHEET A6

NOMENCLATURE: PISTOL, AUTOMATIC, CALIBER .22, SILENCED

PURPOSE: To eliminate sentries or other enemy personnel by stealthy attack without causing widespread alarm.

DESCRIPTION: This is a .22 caliber, clip-fed automatic pistol with a special silenced barrel. The clip will hold 10 rounds of .22 caliber high speed, long rifle ammunition.



SPECIAL FEATURES: The silenced barrel gives considerable reduction in noise. No muzzle flash is visible, even in darkness. The range and accuracy are unaffected and remain the same as in the unsilenced piece.

The silencer housing is removable for cleaning purposes only. A bristle brush and complete operational and cleaning instructions are packed with each piece. The silenced barrel requires special cleaning to remove the carbon from the enclosed wire-mesh screens. The pistol will sound louder if not properly cleaned.

DATA:

Ammunition must be ordered separately

Length, overall	14 in.
Weight	2 lbs. 2 oz.
Number of units per carton	1
Weight of carton (including spare screen)	3½ lbs.
Number of cartons per case	15
Weight of filled case	75 lbs.

ISSUED BY: OSS

ORDER AS: Pistol, Automatic, Cal. .22, Silenced. (Code: s.22)

RESTRICTED

ISSUE NO.6
R & D

NOMENCLATURE: BARREL, SILENCED, S.M.G., M3, CAL. .45

PURPOSE: To reduce the muzzle blast.

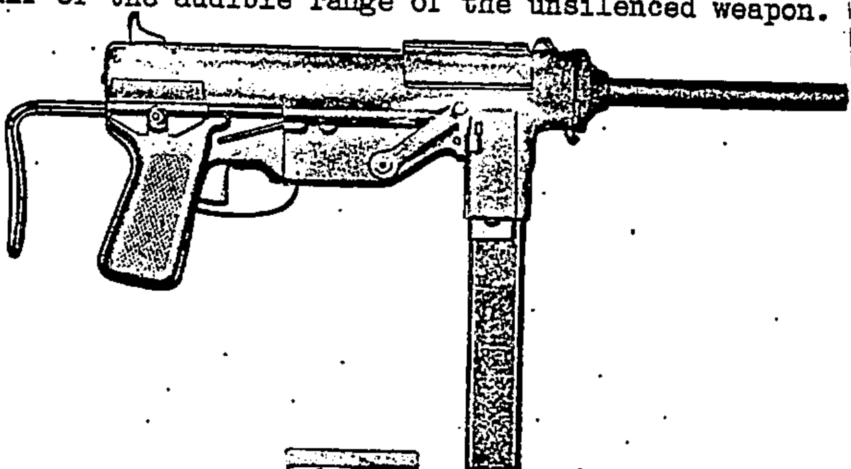
(b)(3)
NatSecAct

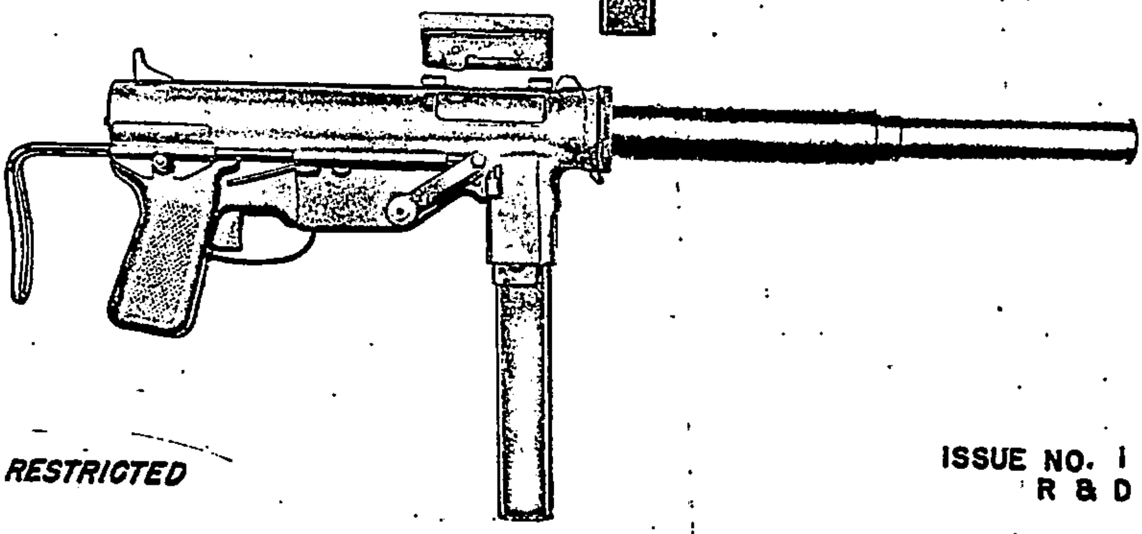
DESCRIPTION: The silencer consists of a barrel and barrel extension which are screwed together. [redacted]

FUNCTION: [redacted]

(b)(3)
NatSecAct

The report of the silenced M3 sub-machine gun becomes inaudible at 200 to 800 yards, depending upon the terrain. This is slightly less than half of the audible range of the unsilenced weapon.





SPECIAL FEATURES: The silenced barrel requires special cleaning to remove the carbon [redacted] If not properly cleaned after 150 to 200 rounds, the gun will sound louder. Cleaning instructions and a bristle brush are packed with each silenced barrel. The silenced barrel is interchangeable with the standard barrel.

(b)(3) NatSecAct

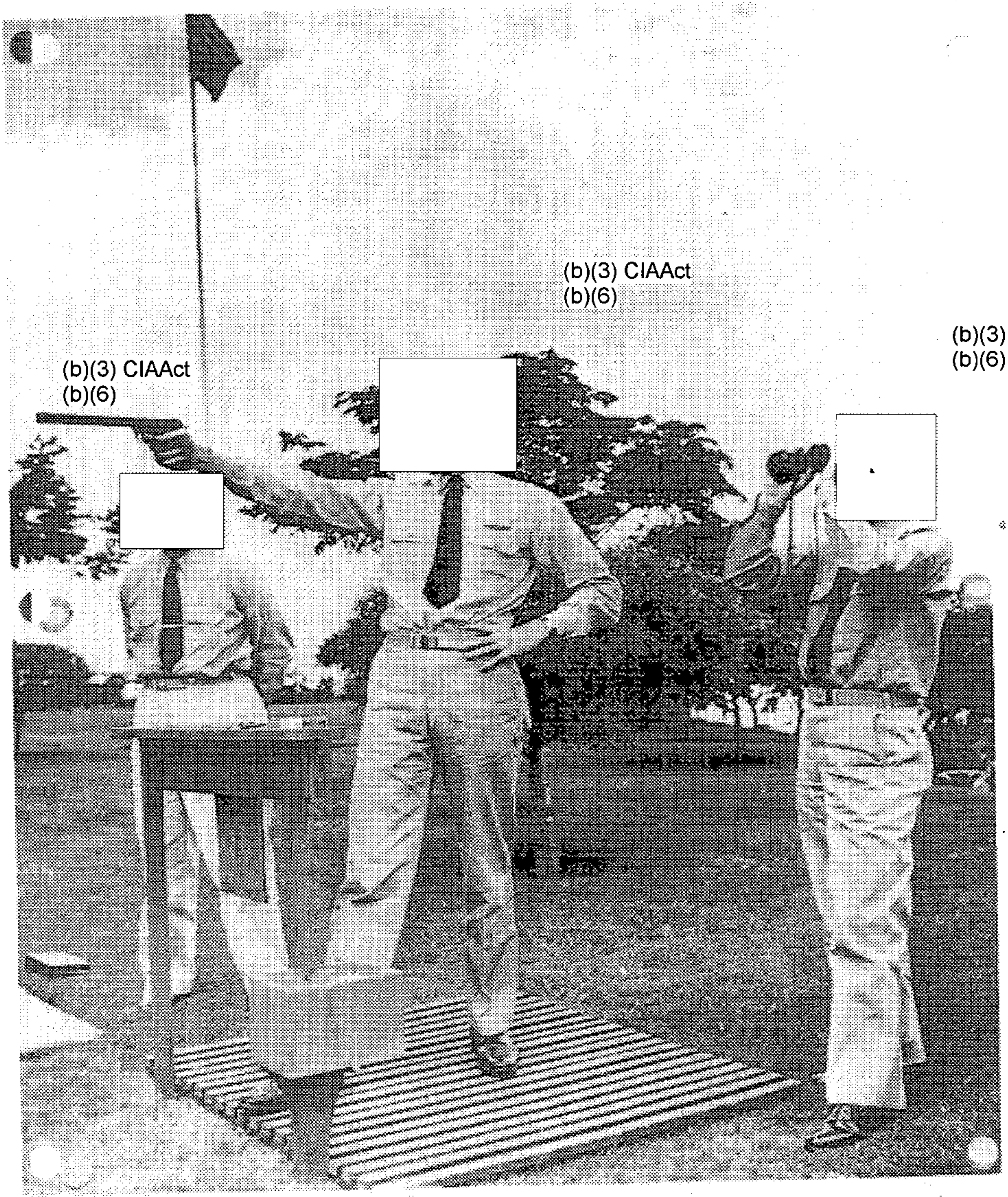
DATA: M3 sub-machine guns are <u>not</u> shipped with the silenced barrels <u>unless</u> specifically ordered.

Length of barrel only ———————— 14½ in.

Weight of barrel only ———————— 1½ lbs.

ISSUED BY: OSS

ORDER AS: Barrel, Silenced, S.M.G., M3, Cal. .45



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(b)(6)

(b)(3) CIAAct
(b)(6)

(b)(3) CIAAct
(b)(6)

Approved for Release: 2018/06/04 C03126390

(b)(3) NatSecAct

Classification: Confidential

SAC-15 ROCKET

Operational Background

In the OSS type of operation the need existed for what might be termed a saboteur's artillery piece. Due, however, to the limitations of weight and size, such a weapon as the more conventional field piece or mortar could not be considered. Rockets at once suggested themselves as fulfilling this need because they could be fired from light, expendable launchers. A saboteur could thus be provided with a means of attack from a distance on large, well guarded targets such as oil tanks, police headquarters, warehouses, etc.

General Statement of the Problem

As first received in November 1942, the problem called primarily for an evaluation of existing military rockets, with the particular OSS type of operation in mind. This evaluation was completed by February 1943, following which the problem remained completely inactive until revived in October 1944. During this interval, Division 3 had developed a large assortment of rockets.

As presented then, it was an entirely specific request for the development of a launcher and carrying tube capable of giving good accuracy at 1000 yards and using the 3.5-inch Spin Stabilized Rocket.

Historical Background

(b)(3) CIAAct
(b)(6)

Upon receipt of the original problem, the full information of Division A was made available to OSS and SOE, and preliminary work on a modification of an existing rocket was begun by [redacted] As a result of these activities, Mr. Lovell decided in February 1943 that the OSS and British requirements would be satisfactorily filled by the then recently released Bazooka. This prompted those at MRL to study the firing of the Bazooka using the packing carton as the launcher. By experiment it was learned [redacted]

(b)(3) NatSecAct

At the same time a very simple sighting device was invented, and with this arrangement fairly satisfactory results were shown to be obtained at close range (100 feet). This work was finished in June 1944, and in August OSS

received a specific field operational requirement for a large number of more accurate and heavier rockets having a range of 500 to 2000 yards.

Since the problem had been handled for the Division by [redacted] at MRL, he assumed the responsibility of clarifying this field requirement. This was accomplished in October with the submission of a specific problem utilizing the 3.5 SSR which had been developed by Division 3 at the California Institute of Technology for the Navy. This rocket had been made in an experimental order of 10,000 rounds, and at the time it was believed that these rounds could be made available to OSS. Due to its extreme accuracy, light weight, and excellent penetrating power, this rocket recommended itself and the immediate problem became the invention of a launcher which would function as a carrying tube, be as light and strong as possible, and provide good accuracy at a range of 500 to 1000 yards.

(b)(3) CIAAct
(b)(6)

Division 19 secured the excellent cooperation of Division 3 with [redacted] authorizing the performance of the experimental work at [redacted] and an OSS officer assuming the responsibility for much of the developmental work. By the end of November, a preliminary model had been constructed and demonstrated at Camp Pendleton, California.

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After a series of trials with this model, another was made of aluminum, and trials of this during January 1945 convinced OSS that their problem had been essentially solved. From that date until the termination of the OSS activities in July 1945, MRL acted as consultants in the procurement of 500 of these launchers.

It was unfortunate that the device did not reach full development in time to have gone into use in the field, for the Division personnel felt that a contribution had been made to rocket launching, and a lighter, cheaper, and more accurate launcher had been devised than was then available to either the Army or Navy.

Part of the summer was consumed in fulfilling an additional request presented in April by Colonel Jeffries. It was desired that the launcher for the 3.5 SSR be adapted for the firing of the Bazooka rounds. This [redacted] very quickly accomplished by the perfection of an adapter consisting of three rods which could be quickly inserted in the launcher tube and provided rails on which the Bazooka round could travel.

(b)(3) CIAAct
(b)(6)

Mention should also be made of the negotiations which attended the release to OSS of the 10,000 rounds previously mentioned. Through the good offices of [redacted] Chief of Division 3, and Dr. Bush, it was eventually arranged between OSS and the Navy that both groups should have call on the 10,000 rounds, shipment of which had been made to General Wedemeyer in the China Theater where both Services were planning to operate.

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Had the war lasted long enough, the 500 rocket launchers would have been dispatched to that theater and used in a very large operation, the results of which would have determined the future production of the 3.5 SSR.

Technical Information

[redacted]

(b)(3)
NatSecAct

Formally Submitted: November 12, 1942. Problem Terminated: February 19, 1943.

Problem Revived: October 17, 1944. Problem Terminated: June 30, 1945.

Contract: OEMsr-955 with [redacted] official investigator.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Final Report: NRL Report No. 220 of October 25, 1945, entitled "Rocket Launcher," by [redacted]

(b)(3) CIAAct
(b)(6)

Patent Report: Invention report on sight for launching rockets was submitted to Captain [redacted] on April 11, 1945.

(b)(3) CIAAct
(b)(6)

(b)(3) NatSecAct

[redacted]

Approved for Release: 2018/06/04 C03126390

Classification: Secret (dropped to Restricted April 1944 at the request of the Engineers)

SAC-16 AUNT JEMIMA

Operational Background

On November 28, 1942, it was suggested to Mr. Lovell, then the Chief of the Research and Development Branch of OSS, that there was need, particularly in the Near East and the Far East, for camouflaged high explosives. The proposal was made that work be undertaken to develop an explosive cloth, since it was felt that peasants and non-suspicious travelers could carry such material without the slightest risk of detection into occupied regions and there could use it to good advantage. Accordingly, the Director's Subcommittee was asked to undertake the study of such camouflaged explosives, and this work resulted in two endeavors: one was the preparation of the originally requested material, namely an explosive fiber capable of being woven into cloth, and the other was the development of a high explosive mixture camouflaged as flour and properly called "Aunt Jemima."

(b)(3) NatSecAct

The latter material was produced to the extent of about 15 tons by NDRC under a [redacted] contract for OSS and was shipped to China, where a large store of it still existed in June 1945, although operational reports indicated that some of the material had seen Service use.

General Statement of the Problem

The original suggestion calling for the development of an explosive cloth did not appear at the time to be promising, and a counter-suggestion made by Dr. George B. Kistiakowsky, Chief of Division 8 and a Member of the Director's Subcommittee, was agreed upon as the objective of the work. The problem was therefore phrased to call for the development of a flour high explosive mixture capable of use as a high explosive with or without separation of the inert material and in addition capable of being used as flour in the preparation of biscuits, pancakes, etc. It was desired lastly that the baked product should be non-toxic, even if not particularly nourishing. The reason for the last point lay in the belief of OSS that flour in these hungry countries would be tempting. Finally, it was required that such a flour mixture should be safe to transport, non-suspicious in the dry state, and capable of detonation by standard Army stores.

Historical Background

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Dr. Kistiakowsky made available to the Director's Subcommittee the service of [redacted] employee who had been assigned to the Explosives Research Laboratory at Bruceton, Pennsylvania, operated by

Division 8. [redacted] undertook in December 1943 preliminary experiments to determine whether such a flour high explosive mixture would be feasible.

At the start, his work included [redacted] Good progress was made, and on January 2, 1943, [redacted] reported that a [redacted] flour mixture could be detonated in the ballistic mortar satisfactorily and give authentic looking pancakes. One such pancake was allowed to remain on the griddle until it had completely charred with no unusual effects, thus demonstrating the stability of the mixture to heat. Similar baking tests of [redacted] flour mixtures did not prove successful, and this particular high explosive was dropped from further consideration.

(b)(3) NatSecAct

At the same time the assistance of Division 9 was secured, and [redacted] was asked to run tests on the toxicity [redacted] when administered orally to test animals. He reported in January of 1943 that approximately 7 grams [redacted] could be tolerated by man, while [redacted] was considerably more toxic and other explosives [redacted] were extremely toxic. These results were in general agreement with similar experiments performed [redacted]

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From this it appeared that some other explosive would have to be found if the toxicity requirement laid down was to be met. Experiments were therefore run on an analog of [redacted] This material was formed as a by-product in small amounts in the [redacted] process for the preparation [redacted] Animal tests with this material indicated that it would be the best, since calculations indicated that a man could tolerate approximately 8 ounces. At the same time it was established by [redacted] that [redacted] was entirely comparable with [redacted] in its behavior when mixed with flour.

(b)(3) NatSecAct

It appeared therefore by March 1943 that the original request had been satisfied on an experimental scale. This was on the assumption that [redacted] would not prove too sensitive a high explosive when handled in this manner. This was not an academic question because [redacted] and ways were known to assure that [redacted] would be in this form.

It appeared likely to OSS that a large requirement might exist for Aunt Jemima, and a meeting took place on March 25, 1943, between Mr. Lovell, Dr. P. A. Bengis of Army Ordnance, and [redacted] Chief of Division 8.2. As a result of this meeting, Army Ordnance expressed its willingness for the use by NDRC and the [redacted] of a pilot plant known as the "Jeep," which had been built by Division 8 at the Holston Ordnance Works and later turned over to Army Ordnance. This pilot plant was to be used in the preparation of a large quantity [redacted] for semi-production of Aunt Jemima, and it was an interesting problem, inasmuch as [redacted] had up to that time been considered a laboratory curiosity and an undesirable by-product in the [redacted] process.

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By May the OSS requirement had been confirmed at approximately 25,000 pounds. This was the result of tests performed by the Navy through OSS auspices of material provided by [redacted]. A formal request therefore passed from OSS to NDRC and to Army Ordnance for a joint program which would result in the production of the requested amount. The Ordnance Department agreed to furnish the pilot plant and the high explosive provided NDRC would work out the process for preparing large quantities of HMX and would supply thenecessary supervisory personnel. This Division 8, through [redacted] under contract with Division 8 showed by July that the operation of the pilot plant would be entirely feasible.

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At the same time, Dr. Kistiakowsky as a member of Division 19 negotiated a contract with the Explosives Division [redacted] to carry out the manufacturing of Aunt Jemima [redacted] to be delivered by Ordnance. A meeting of all interested parties took place on July 9, 1943, at which time the various details were arranged, and the whole program of semi-production by this joint group proceeded without incident.

(b)(3)
NatSecAct

The Jean turned out 25,000 pounds of pure [redacted] which was furnished to the [redacted] between August 10 and November 10, 1943. [redacted] had set up their own pilot plant and had used this [redacted] for the production of 30,820 pounds of Aunt Jemima by the end of December 1943. At that time the full production was shipped to the Fall Brook, California, Arsenal of the Navy, and OSS reimbursed NDRC for its expenses. Shipment was in bulk with the responsibility for sacking left to the field distribution center.

(b)(3)
NatSecAct

[redacted] prior to its large scale manufacture, demonstrated the feasibility of the process using [redacted] flour mixtures, since those were more available at that time. This resulted in the preparation of approximately 1000 pounds [redacted] of Aunt Jemima. All of this material was consumed in experiments at [redacted] and later at MRL and the Engineer Board. It should be noted here that [redacted] is entirely suitable for the preparation of Aunt Jemima in all points except toxicity.

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NatSecAct

(b)(3) NatSecAct

The MRL tests with this material were performed over a period of months, beginning in October 1943. They resulted in definition of the proper methods for initiation of both the dry preparation, baked product and dough. Indeed, it was found that the inclusion of approximately 20 percent water with Aunt Jemima gave a dough which had very desirable plastic qualities and that this plastic explosive was nearly as effective as the ordinary PE composition C2 used by the Engineers and the Ordnance Department.

Major John Jeffries, assigned to the project by OSS, demonstrated in February that Aunt Jemima in this form would not burn or detonate when penetrated by 50 caliber tracer ammunition. This discovery was of considerable interest since the Navy and the Engineer Board had been seeking a small plastic explosive with this property for front-line field demolition work. Tests run at Aberdeen, and in April at the Engineer Board, confirmed the discovery, and the Engineer Board requested a quantity of material for further trial at

Fort Pierce. Approximately 200 pounds were provided, and in view of the satisfactory results, the Engineers dropped the classification of the material to Restricted and attempted to locate a manufacturer for an order of 10,000 pounds. They were not successful in this, since [redacted] (b)(3) NatSecAct [redacted] was unwilling, having already dismantled the NRC pilot plant.

(b)(3) NatSecAct

It is safe to say that should any further production be undertaken it would be with [redacted] instead of [redacted] for the toxicity angle would ordinarily be of no importance.

As an off-shoot of the problem on camouflage (SAC-30), ERL during December 1943 explored the possibility of camouflaging Aunt Jemima in ways other than sacked flour. In this they were favored by the fact that Chinese flour was found to have a definite grey cast. It was therefore easy to take Aunt Jemima water mixtures and mold them into the form of common Chinese objects which were ordinarily made of clay. A number of such objects were made including bricks, flag stones, rocks, tiles, etc. These camouflaged objects were found to have explosive properties comparable to the original Aunt Jemima, and OSS requested that the man at ERL (Mr. Maurice Coon) who had done this work be sent to the Far Eastern Theater to supervise work in that area. His services were provided to OSS by OFS, and he spent over a year in the China-Burma-India Theater.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

One additional aspect needs a word of description. As early as January 1943 attempts were made to disguise high explosives with salt, sugar, Plaster of Paris, and cement. The last two of these came to naught, for mixtures having suitable explosive properties had other undesirable features, being in general too sensitive to handle. The salt and sugar mixtures were more promising, and considerable work was done on them by [redacted] at Bruceton and later confirmed by [redacted] It was found possible to prepare a mixture of these materials with [redacted] or other high explosives which could be detonated without separation of explosive from inert material. However, mixtures having this desirable property were invariably too sensitive to be safe, and since OSS did not wish a mixture requiring separation in the field, these mixtures were not further investigated.

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(b)(3) CIAAct
(b)(6)

The original suggestion of the development of an explosive fiber or cloth, which as described resulted in the conception of the idea of the Aunt Jemima, did not entirely disappear. In January 1943, the advice of [redacted] was solicited. He seemed well suited to consider the problem in view of his success under a Division 9 contract in developing a protective cloth woven from fibers containing as much as 40 percent of activated carbon. After conversations with Dr. Kistiakowsky, [redacted] then at the [redacted] agreed to enter into a contract to investigate the possibility of making similar high explosive fibers. This work, which began in May 1943, resulted by the following December in the development of [redacted] These fibers were suitable for manufacture by existing textile machinery, and it was believed that they could be formed into threads, and that cloth could eventually be

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woven from them. No manufacturer appeared willing to undertake this rather hazardous job, however, and because of the great success achieved in the Aunt Jemima development this particular work was not carried further.

Technical Information

1. Aunt Jemima.

[redacted]

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[redacted]

(b)(3) NatSecAct

2. Explosive Fiber.

[redacted]

(b)(3) NatSecAct

Problem Submitted: November 21, 1942. Problem Terminated: July 6, 1944.

Contracts: OEMsr-202 between [redacted] and Divis[redacted] official investigator. On May 6, 1943, $10,000 was transferred from Division 19 to Division 8's budget to cover the cost of the work.

(b)(3) CIAAct (b)(6) (b)(3) NatSecAct

OEMsr-1102 with the [redacted] official investigator; June 1, 1943, to December 1, 1944.

(b)(3) CIAAct

OEMsr-1022 with [redacted] official investigator; May 15, 1943, to March 15, 1944. OSS reimbursed NDRC for the material delivered to them, namely [redacted] which was made at a cost of [redacted] used, which were provided free by the Army.

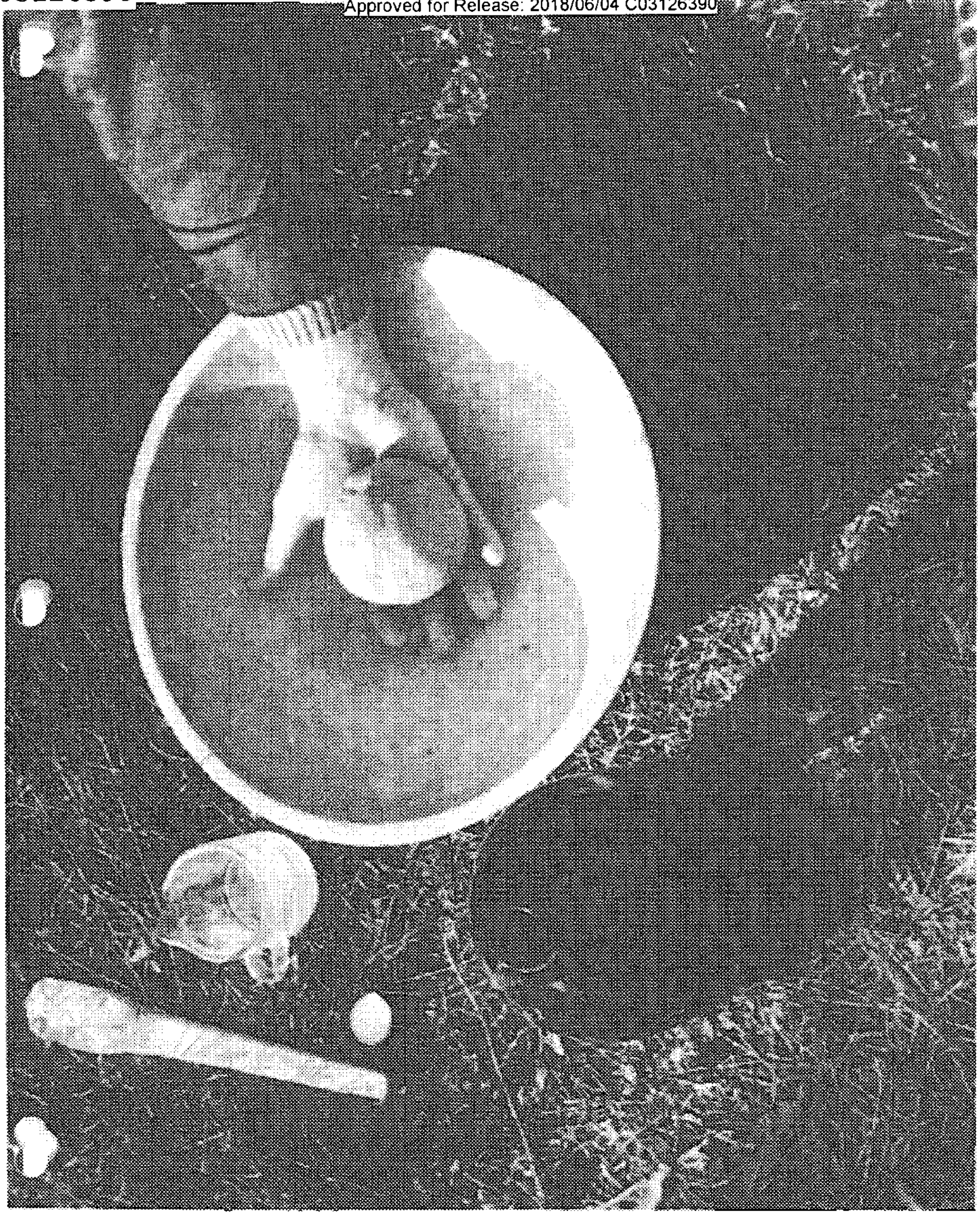
(b)(3) CIAAct (b)(6) (b)(3) NatSecAct (b)(6) (b)(3) NatSecAct

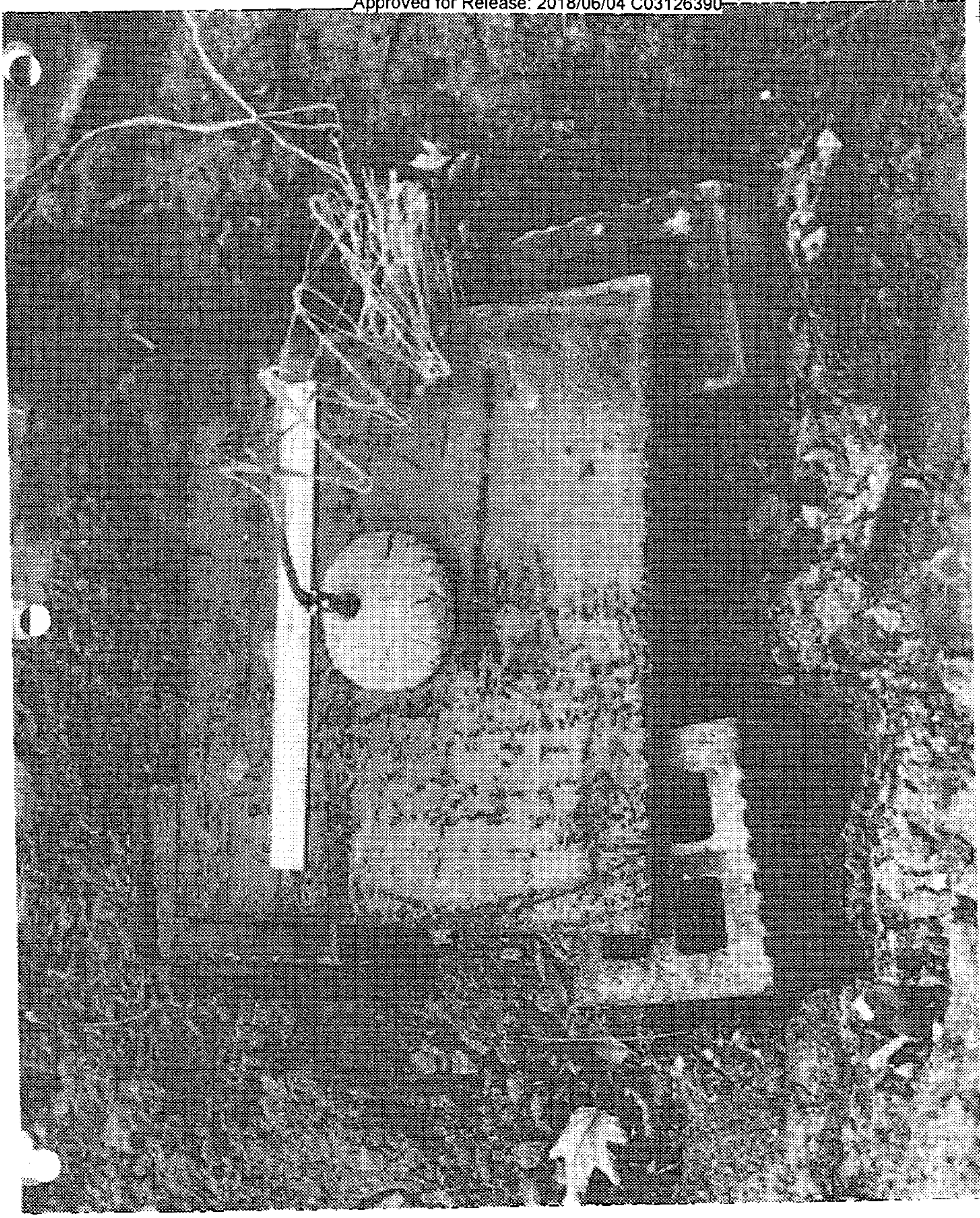
Final Reports: Division 19 Serial No. 16, OEMsr-1102, forwarded to Dr. [redacted] on September 11, 1944; Division 8 submitted a full report on the "Pilot Plant Production of HMX" on November 10, 1943; Division 19 Serial No. 7, OEMsr-1022, submitted to [redacted] on March 10, 1944.

(b)(3) CIAAct (b)(6) (b)(3) CIAAct (b)(6)

Patent Reports: Invention report by [redacted] Kistiakowsky, submitte[redacted] to Captain [redacted] on May 17, 1944, under [redacted] Contract [redacted] patent was later taken out by the Army (OSRD 1981). Patent report under OEMsr-1102, forwarded to Captain [redacted] on February 8, 1944; invention report under OEMsr-1022 forwarded to Captain [redacted] on May 17, 1944.

(b)(3) CIAAct (b)(6) (b)(3) CIAAct (b)(6) (b)(3) NatSecAct (b)(3) CIAAct (b)(6)





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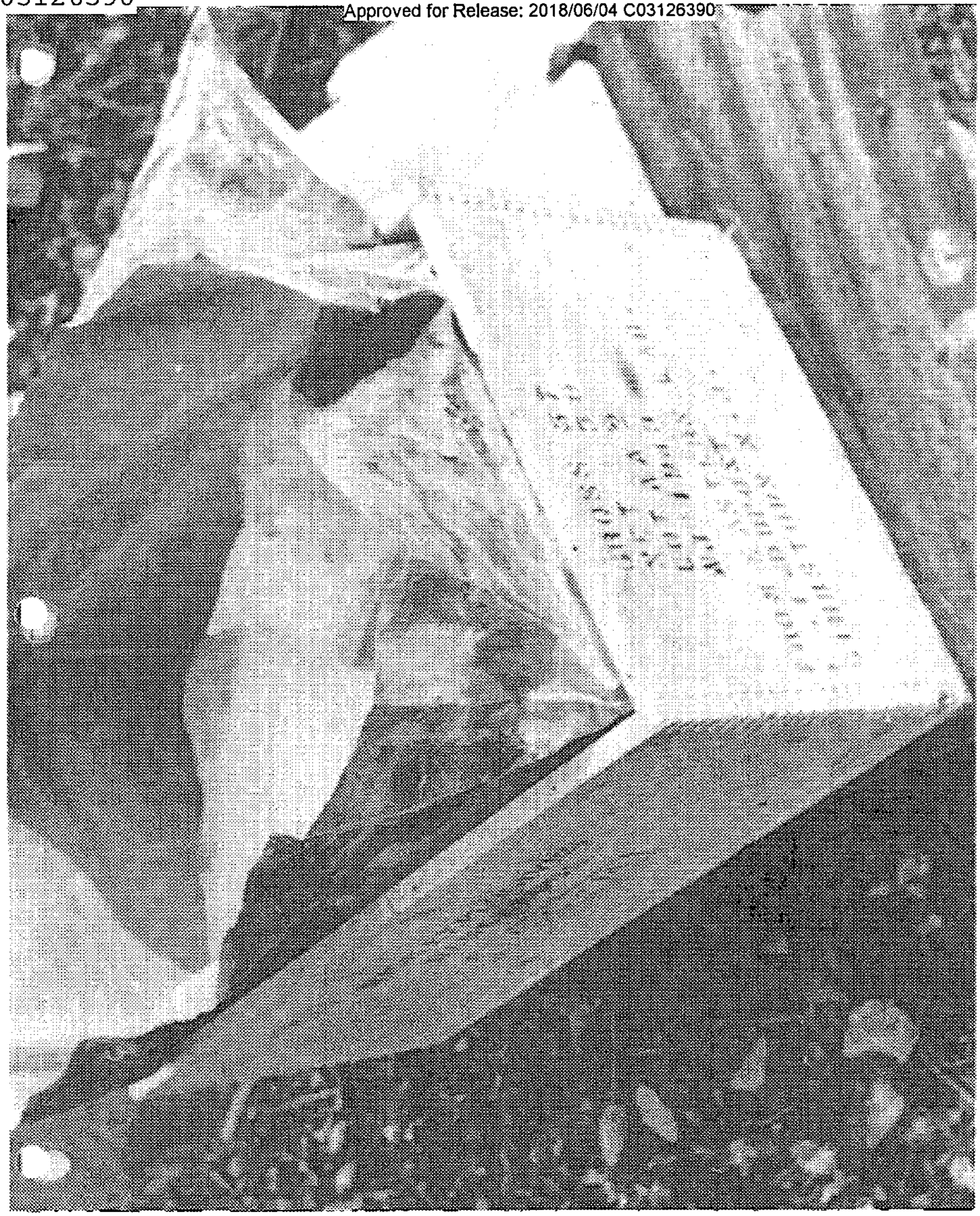

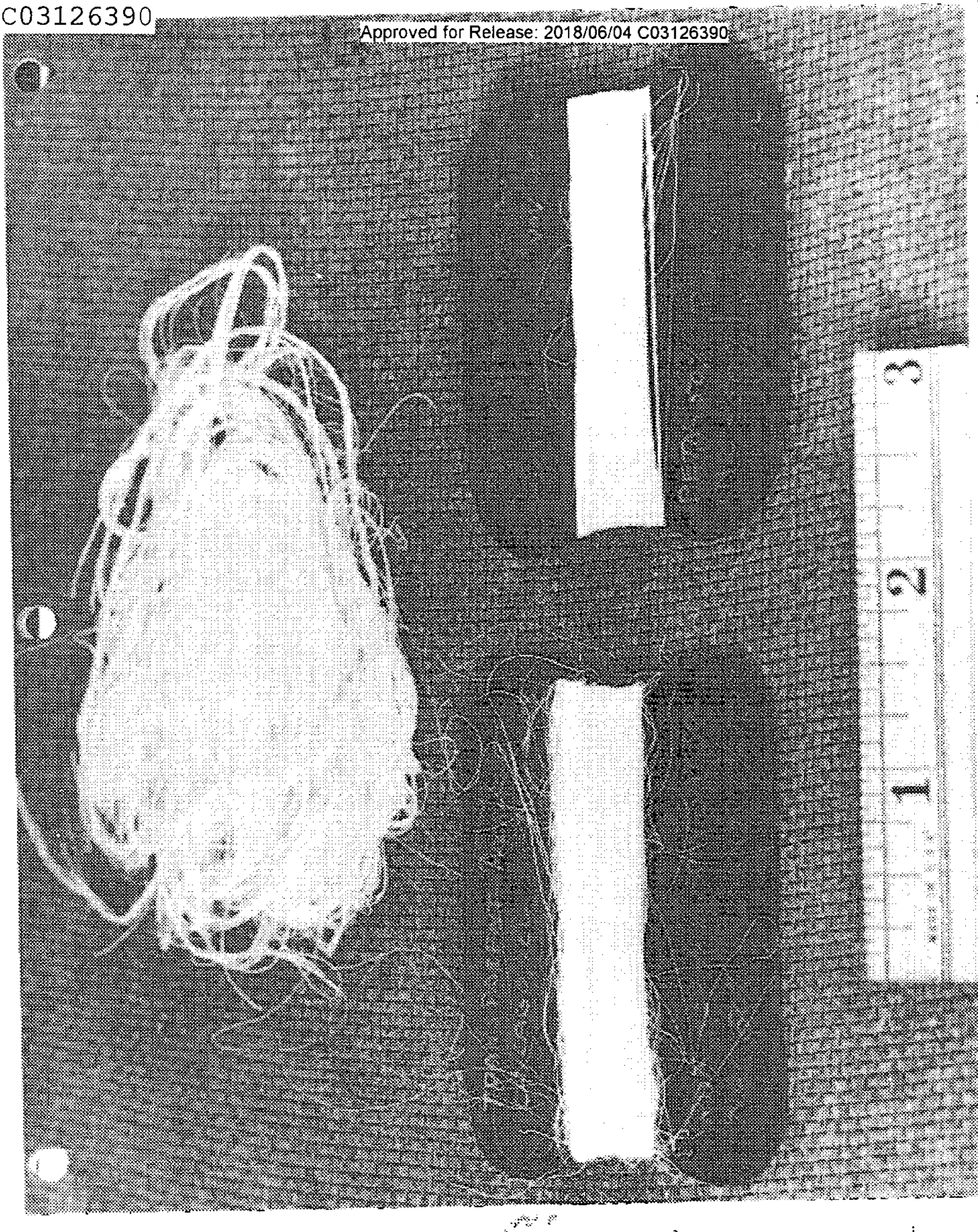

SAC-17 HONEYMOON

Part I: General

Operational Background

The need for delayed initiation of sabotage devices is apparent. Agents must be protected. This is best achieved by the use of a suitable time delay, coupled to the incendiary or explosive charge. In fact, without suitable time delays it would be impossible to secure agents willing to undergo the hazards of escape. Time delay devices may be anything from the crudest sort which will activate at an unpredictable time and place to an accurately timed precision delay whose moment of action can be known with exactitude for hours or days in advance.

In this broad field not all times were of equal value to OSS and SOE operators; for example, the very precise pyrotechnic delays of the order of a few seconds were not suitable, and on the other hand long delays over a period of days were seldom needed, for the chance of discovery of a planted device naturally increased with the length of time during which it remained inoperative. Somewhere between these extremes lay the useful range of timings.

Long before OSS and Division 19 appeared on the scene, the British had explored this range and had developed two principal delays. The first, known as the Time Pencil, depended on a chemical action, and the second, known as the AC Delay, depended upon a physical solution of a plastic member by organic solvents. The work had extended only tentatively to clockwork delays, for they did not feel an urgent need for great precision in operations. Both of the above delays were subject to severe criticism, while still admittedly the best available. They were both badly affected by temperature change, the Pencil notably so, and they were not reporducible, so that the exact time when a given unit would fire had a measure of uncertainty about it which in general exceeded 20 or 30 percent of the mean time. Should it happen in an operation that a delay operated prematurely due to this variance, very serious consequences could be expected. Accordingly, the British were ever in search of more accurate systems on which to base their time delays and their own research on the subject served to stimulate the American work on the problem.

General Statement of the Problem

The problem existed, therefore, to find a better time delay, and the Division attacked the problem with a free hand after examination of all systems which were suitable.

Historical Background

This is discussed individually for each of the main subjects of Division 19 research and development. It is not felt necessary here to sum up the progress of the whole. Each of the devices given below proceeded simultaneously in its development and in general with coordination between workers on the different contracts. This coordination was supplied by the activity of the Pencil Research Committee and the Pencil Research Subcommittee, as well as the function of Dr. W. C. Lothrop as coordinator. In addition to the devices given full treatment, there were many types of time delays which were considered at one time or another. A very brief detail of these appears also:

Technical Information

[redacted]

Problem Submitted: December 22, 1942. **Problem Terminated:** June 30, 1945.

Part II: The Early Work

[redacted] (b)(3) NatSecAct

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(b)(3) NatSecAct
(b)(6)

Historical Background

The original group in Section 8-0-C contained as one of its members [redacted] ing in June 1942 he was in frequent contact with [redacted] a representative of SOE. At that time SOE was interested in a convenient pocket incendiary and [redacted] from other work in Division B, had developed an incendiary based on [redacted] This was later abandoned when the Pocket Incendiary was accepted (November 1942); however, it provided an original contact for [redacted] and on a visit to Chicago in July 1942 he presented several problems on which he desired work. These were conducted under a Division B contract which was then set up. They included the development of a waterproof clockwork mechanism for use on Limpets, the development of an add-water type of battery, and the development of a capsule delay depending for its time on the period required for concentrated sulfuric acid to eat through gelatin.

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[redacted] worked on these problems with the cooperation of the [redacted] respectively. Samples of his developments reached the Director's Subcommittee before January 1943. It appeared to them that a promising beginning had been made and that further work on time delays would be better placed with another contractor.

(b)(3) NatSecAct

In April 1943 it was first learned that the [redacted] had a direct contract with the Engineer Board also on the development of clockwork delays. This contact was followed aggressively in connection with the [redacted] developments later.

(b)(3) NatSecAct (b)(3) NatSecAct

Technical Information

[redacted]

(b)(3) NatSecAct

(b)(3) NatSecAct

[redacted]

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Contract: OEMsr-602 with [redacted] [redacted] official investigators; July 1, 1942, to June 30, 1943.

(b)(3) CIAAct
(b)(6)

Final Report: Division 19 Serial No. 2 forwarded to [redacted] on August 16, 1943.

(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded to Captain [redacted] on January 4, 1944. The contract originated in Section B-9-C, was transferred to Division 11 in January 1943 and to Division 19 in May 1943.

(b)(3) CIAAct
(b)(6)

[redacted]

(b)(3) NatSecAct

Historical Background

In Section B-9-B work on a problem received from the Navy and entirely different from the time delay problem had resulted in the discovery at [redacted] of the so-called "expanding plug." This consisted in its complete form, as described in a report of August 16, 1943, of a stack of cellophane washers compressed by spring tension with a load of 3 to 5 kilograms. The resulting plug when immersed in water was found to swell at a fairly uniform rate, not very susceptible to temperature and to be capable thereby of doing mechanical work. It was thought that this device might be useful for the arming or detonation of Limpets, and this was looked into in March 1943, when visits were arranged for [redacted] and Director's Subcommittee personnel. It was decided that the expanding plug had no likelihood as a replacement for the AC delay in Limpetry, and accordingly the idea lay dormant until October 1943, when the requirement arose for a device resembling the Firefly (SAC-21) but actuated by water rather than gasoline. [redacted] thereupon visited [redacted] and a program was laid out of experimentation. This came to nothing, and soon thereafter OSS found another and better solution to the problem based on the AC delay.

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(b)(3) CIAAct
(b)(6)
(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Technical Information

[redacted]

(b)(3) NatSecAct

[redacted]

(b)(3) NatSecAct

Contract: OEMsr-572 [redacted], official investigator; July 1, 1942, to June 30, 1943.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Final Report: Submitted to [redacted] from Section 11.0 acting for Section B-9-B on January 26, 1944.

(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded to Captain [redacted] on February 19, 1945.

(b)(3) CIAAct
(b)(6)

Part III: Organic Fibers

Historical Background

OSS had approached the Nylon Division of the [redacted] (b)(3) NatSecAct Company in early November 1943 with the suggestion that the Mark I Pencil might be modified by the replacement of the iron tension wire with a nylon thread. Nylon seemed promising because of its well-known resistance to cold flow. The Nylon Division proceeded with a few experiments in which nylon threads having a breaking strength of 31 pounds were attacked with nitric acid or a 20 percent solution of calcium chloride in methanol. It appeared that a time delay based on this principle was possible although its temperature coefficient and reproducibility did not look promising from the first experiments. Nevertheless, OSS formally requested the Division on November 15 to develop a time delay based on this principle.

(b)(3) NatSecAct Meetings thereupon took place with officials of the [redacted] and (b)(3) NatSecAct it was decided that the work would be more properly handled by [redacted] A contract was thereupon set up for the investigation of nylon and other fibers; the latter including methyl-cellulose, ethyl-cellulose, acetate, and regenerated fibers of various properties extensively used in tire fabrics (Cordura and Fiber G).

(b)(3) NatSecAct On January 15, 1944, [redacted] Dr. W. C. Lothrop visited the [redacted] plant, discussed the details of the problem which at that time was presented as the development of a substitute for the Mark I Pencil, and left samples of the Pencil, the AC Delay, and the British Plastic Pencil. Work had already shown that a regenerated fiber known as Cordura, when under a tension of about 37 percent of its breaking load could be attacked with a solution of sodium hydroxide with nearly a zero temperature coefficient. This amazing phenomenon appeared to be due to two simultaneous and competing reactions with different temperature coefficients between the regenerated cellulose fiber and the alkali.

(b)(3) CIAAct
(b)(6)

In mid-February, [redacted] MRL visited the contractor and gave advice on the establishment of testing stations and suggested the possible use of the system as a replacement for the AC Delay. By May Cordura had been more fully explored but it appeared necessary to go beyond the maximum delay of 30 minutes, which was obtainable by that system.

(b)(3) NatSecAct

From that time on the work of the contractor was fully discussed at monthly intervals by the Pencil Research Subcommittee [redacted] which representatives of the [redacted] and MRL contracts attended together with Service representatives. At a June meeting of this group the [redacted] representatives presented a report indicating that a time delay based upon diffusion of water through a porous pulp board plug offered promising lead. By mutual agreement, this suggestion was transferred to MRL and was

(b)(3) NatSecAct

intended for full exploration. This never came about because of the press of other work and the success attending the [redacted] developm(b)(3) NatSecAct of the Mark II Pencil.

At another meeting of the Subcommittee in late June, Fiber G was found to be mechanically superior to Cordura and to possess the similar property of zero temperature coefficient. Like Cordura, however, it showed tendencies to cold flow and was extremely sensitive to loading variation and alkali concentration. At the Subcommittee meeting in July, a series of negative results were reported on attempts made to correct the above deficiencies. Despite diligent work, the results were most disappointing, and at the August meeting of the Subcommittee it was agreed that a system using organic fibers had no promise and accordingly the contract was closed.

Technical Information

Both Fiber G and Cordura are high-tenacity, regenerated cellulose fibers. They are standard production items [redacted]. In the work (b)(3) NatSecAct reported here, Cordura is a 2-ply cord having a tenacity of 36.5 lb. and an elongation of 10%. Fiber G has a tenacity of 35 lb. and an elongation of 9%. The two fibers are therefore comparable. They differ somewhat in the twist and ply and in the denier. The work indicated that all of these variables have a great effect on the timing. Cordura loaded to 34% of its breaking load and immersed in either 5.2 or 4.2 sodium hydroxide gives a temperature coefficient which is near zero and breaking times of 10-20 min. Attempts to extend this time by the introduction into the solution of glycerol and salt results in no improvement. Fiber G in a 10% sodium hydroxide solution acts much like Cordura, and neither fiber responds well to attack by organic bases. Work was done which indicates that a delay could be built and specially prepared Corning Alkali Resistant Glass could be used for the ampoule. However, for timings beyond 40 min. neither fiber shows promise, the reproducibility becomes poor, and the susceptibility of the system to a number of minor variations was demonstrated to be large. Moreover, the zerotemperature coefficient does not persist throughout the whole range of timings. These two fibers were therefore not considered of value.

Nylon was explored sufficiently to show that it also had no promise. To be sure a zero temperature coefficient is obtained when a nylon strand is attacked by a solution of 2.8 percent nitric acid saturated with potassium nitrate. Aside from the difficulty of handling a nitric acid solution in manufacture and in the field, the major disadvantage in this system is the slush formed at low temperatures in the corrosive solution by precipitating salt. It was found here also that minor variations in the filament diameter have enormous effect on time.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Contract: OEMsr-1325 with [redacted] official investigators; December 20, 1943, to October 31, 1944.

(b)(3) CIAAct
(b)(6)

Final Report: Division 19 Serial No. 19 forwarded to [redacted] on December 4, 1944.

(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded to Captain [redacted] on November 3, 1944; no inventions were made.

(b)(3) CIAAct
(b)(6)

Part IV: Mark I Pencil

A. [redacted] (b)(3) NatSecAct

Historical Background

The first approach of an SOE representative to NDRC was concerned with the subject of improving the reproducibility and time of the so-called Mark I Pencil. This simple time delay device was an invention of the British and had been in large-scale production by them for some years before the arrival in this country of [redacted] Since production facilities in England were strained, his first task on arrival was to secure adequate American facilities, and the first Pencil produced on this side of the ocean was known as the SRA-1 (Signal Relay American, first model).

(b)(3) CIAAct (b)(6) (b)(3) CIAAct (b)(6)

In May 1942, [redacted] was put in touch with [redacted] [redacted] through Dr. H. M. Chadwell. Rather mysterious conversations then took place, for while [redacted] was anxious that work should begin on improvement of the Pencil, for security reasons he did not wish to divulge the nature of the Pencil and he was unable to supply any number of Pencil parts for study. This high security appears in retrospect to have been rather ridiculous, inasmuch as fully one-third of the British production which was dropped in occupied Europe had already falled in the hands of the Germans and was used by them for their own pruposes.

(b)(3) CIAAct (b)(6) (b)(3) NatSecAct (b)(3) CIAAct (b)(6)

The Pencil, it may be said now, is of simple construction. It consists in essence of a striker held against a spring by an iron wire under tension. This wire passes through a chamber containing a glass ampoule filled with a copper chloride solution. Upon crushing, the ampoule liberates the liquid which is absorbed in cotton wads at either end; and proceeds to attack the iron wire. In time, the tension wire breaks, the striker is forced forward by the compressed spring against a primer cap crimped in the nose, and the whole explosive train is thereupon initiated. In that modification having an incendiary matchhead the device is known as the SRI (See SAC-6). The design which was put into American production by the British with the collaboration of OSS differed only in its snout ending from the standard production of the Engineer Corps. The latter, beginning at the time of SRA-1, came to an end in late 1943 and was not resumed again until about a year afterwards, by which time NDRC and its contractors had done a tremendous amount of work, as will be apparent.

With the extreme secrecy surrounding the [redacted] contract, very little was accomplished in its early months. The workers were not entirely cl(b)(3) NatSecAct as to the problem before them, and even the Technical Aides were not allowed to know the details of the British research program on the Pencil. This ludicrous situation existed until the middle of 1943, by which time

This stimulated a change in security and resulted in an August meeting the interested parties, and by October [redacted] laboratory had 100 tes stations installed, a number of thermostatic chamb rs and temperature studies, and large numbers of various Pencil components. From that ti on, the work done in this laboratory was on an expanded scale and was cerned primarily with the individual items which went to make up the f Pencil. As will be seen in the discussion under Section B, MRL at the time entered the picture and assumed responsibility for the large numb tests of the finished product. Neither contract was involved in the p development of a substitute Pencil, which later became known as the Ma and is discussed in Part V.

(b)(3) CIAAct
(b)(6)

[redacted] of MRL in September and Dr. W. C. Lothrop of Divs 19 in November made inspection visits to the [redacted] whpoints were producing the OSS order. At the same time conversations took pla with the OSS New York and Washington Procurement and with the various officers in OS research. It became apparent that the whole problem of Pencil production and testing was so complicated and had so many ramif tions that it required a steerin. committee and a coordinator to handl properly. The British realized this as well, and the result was the a ment by SOE of [redacted] to act as inspector to the [redacted] Company and to represent the British in decisions on testing and resea

(b)(3) NatSecAct

On November 13, 1943, OSS formally requested coordination and suggeste that a committee be established with an NDRC chairman. On November 29 first meeting of the Pencil Research Committee took place under the ch manship of Dr. W. C. Lothrop, and at that meeting a long and complete was presented and responsibility for the different parts of the resear and testing program was assigned. In addition, a unified procedure fo conductance of tests and the preparation of reports, together with an agreed upon nomenclature, was established. All interested groups desi that the committee should continue, and meetings took place at three o four week intervals from that time until September 20, 1944. [redacted] in his capacity as secretary of this group, furnished most valuable ad and contributed the full cooperation of MRL, which before the program finished was a major contribution.

(b)(3) CIAAct
(b)(6)

The [redacted] contract had now come into quiet water. There was no lon any secrecy surrounding the nature of the Pencil and the purpose of th work, and the group at [redacted] proceeded under the direction of the P

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the Engineer production had ceased and the OSS had assumed the respons bility for fulfilling the SOE requirement in this country, which amoun in the year 1944 to above twelve million units.

In August 1943, it became apparent that the production of an exact dup cate of the British Pencil was a very difficult problem. There were o course differences in American and British manufacturing procedures, a well as differences in materials, and all of these apparently trivial contributed to affect the timing of the SWA-1 very seriously

Research Committee to clear up some 30 major and minor points concerning the manufacture and assembly of the Pencil. The results were immediate. The SRA-1 became the SRA-2. This was brought about when the percussion cap was changed to a waterproof variety. This was followed very soon by the change to the SRA-3, which incorporated a large number of points suggested and developed by the [redacted] contract. The most important of these we(b)(3) NatSecAct revisions in the ampoule specifications and in the method of analysis of the ampoule solutions, adoption of a weight-loading procedure in assembly, and more careful specification for tension wire and the absorbent cotton plugs.

This progress was immediately reflected by an improvement in the production units and from January 1944 to the end of OSS production in June 1945 the team work displayed between [redacted] (b)(3) NatSecAct of OSS was remarkable. Close contacts were established with the manufacturers and with the firms preparing the ampoule solutions. Instructions were given them on methods of analysis and on procedures to improve the uniformity of their product. Charts useful for this purpose comparing specific gravity of solution with composition and comparing them with the resulting delays were prepared and distributed. Many minor points mentioned below in the technical section were also explored and successfully concluded during this period.

(b)(3) NatSecAct By June 1944 the work of producing a Mark II Pencil came to the fore and the [redacted] contract cooperated with the [redacted] contract in the production of electro-galvanized tension wire, and in addition provided a number of parts and facilities for the Mark II work.

In July the Corps of Engineers recommenced production of the Pencil and were invited to send representatives to the Research Committee meetings. The result was the preparation by the Engineers of a new set of specifications incorporating the numerous improvements which OSS had introduced as (b)(3) NatSecAct a result of the [redacted] and MRL work. The specifications were received by the Pencil Committee, and each member independently submitted his criticisms (b)(3) NatSecAct of them, those received from the [redacted] group being the most significant. A critique of the Engineers specifications was forwarded to them by the Committee on October 2 and was gratefully received with the suggested corrections and improvements being at once incorporated in Engineer production. (b)(3) NatSecAct The work of the [redacted] contract therefore directly contributed to a better Army time delay as well.

On September 19, 1944, OSS concluded that the work of the Pencil Committee could be considered complete. At that time, production of Pencils was at the rate of one million per month, the number of rejects was minute, and the British officially reported that the SRA-3 was superior to their own production. Because of the collapse of Germany, their orders were terminated, and accordingly the Pencil Research Committee held its last meeting on September 20.

On September 29 Dr. Fink received a letter of commendation from the Commanding General of SOE, Major General C. McV. Gubbins, CMG, DSO, MC. The [redacted] contract continued its research work until October 31, 194 (b)(3) NatSecAct thereby completing a number of loose ends. During its long life it played no small measure in the production of the most basic initiator used by the OSS and SOE organizations.

Technical Information

In all the [redacted] contract issued 32 progress reports, and references (b)(3) NatSecAct given in the following discussion are to the individual reports. The conclusions reached are briefly summarized in the final report but are of such a detailed nature that it is not felt desirable to give them in any great detail here. The investigations will be treated by taking the different significant parts of the Pencil:

[redacted] (b)(3) NatSecAct

2. Solutions.

The solutions for the red and black Pencils consisted only of water and copper chloride. The analysis and control of them was not a difficult problem. The solutions used in the other four colors of Pencils however contained [redacted] (b)(3) NatSecAct

4. Reaction Chamber.

Report No. 12 indicated that the end plugs which were made of brass required an adequate copper plating to prevent peculiar affects on the corrosion time. Report No. 19 criticized unfavorably the procedure used by the [redacted] in the cleaning of the copper tubes and resulted in a satisfactory method.

(b)(3) CIAAct
(b)(6)

[redacted]

(b)(3) NatSecAct

B. MRL

Historical Background

As was customary in all SAC problems, the facilities of MRL were called upon for testing and approval of the SRA production. Prior to the establishment of the Pencil Research Committee in November 1943, a few reports had been issued which dealt with suggested changes in the OSS production, but with the establishment of the Research Committee MRL took a much more active role in the successful attempt to clear up the difficulties which met attempts to produce an American Pencil equivalent to the British. [redacted] of the MRL staff acted as secretary of the Research Committee and supervised at MRL the large program of testing work which was assigned there by the Committee in its various meetings.

(b)(3) CIAAct
(b)(6)

The routine inspection testing of the production as it emerged from the factory line was clearly the function of OSS and SOE, and Mr. John Collins of the latter organization had full charge of it. The research testing and performance testing of the finished product and of suggested modifications became the function of MRL, and that laboratory was especially valuable as well as an independent check on recommendations received from [redacted] addition, [redacted] because of his professional background, gave invaluable advice on analytical procedures for handling the data, methods of presentation of test results, and standardized performance of timing tests. His recommendations on all of these points were confirmed by the Pencil Committee and became standard with both British and American investigating groups. In addition, MRL under his direction performed significant studies on the use of the Abbe refractometer for the analysis of the ampoule solutions, on re-determination of the temperature charts, on the effect of orientation and type of crushing on time, and on safe packaging.

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct

In all, 25 individual reports were issued by MRL; it is not appropriate to go into their details here. Their scope, however, can be indicated by the following classifications:

1. The inadequacy of the SRA-1 and the SRA-2 production was fully shown by Reports Nos. 21, 24, 25, and 209.

2. Appraisal of the suitability of the different parts used by the manufacturer or projected for use included the following: end plugs, 18; plasticine, 20; solutions, 31, 114, and 124; cotton wads, 49; safety strips, 52; primers, 57; snouts, 58; strikers, 76; packaging in PVC tubes, 117 and 172.

3. Solutions. Analysis of glycerin and copper chloride solutions, as has already been said, proved a difficult problem. The MRL work using the refractive index as a measure resulted in a quick and reliable analytical procedure. The work done by MRL was on solutions prepared and analyzed by [redacted] by the specific gravity and analytical methods. Reports No. 39 and No. 89 give the details. A small amount of research on changes in solution composition was also done at MRL. This included substitutes: raffinose in place of glycerin and iron tin and mercuric chloride in place of copper chloride. Report No. 228 indicates that no success attended this research.

(b)(3) NatSecAct

4. Operational use. The time temperature curves for all colors of Pencils covering the operational temperature range of -10° to +150° F. was an important contribution of MRL. Reports No. 75 and No. 96 give the results of the many hundr d tests which were performed. The tables of temperature corrections thus obtained were accepted by OSS, SOE, and the Engineers and became a standard issue with the packaged Pencils delivered to the field. The importance of this information from an operational point of view cannot be overestimated, for a time delay is of value only if it will perform at approximately the time desired by the operator. Since the Mark I Pencil is very greatly affected by change in temperature, the charts prepared by MRL are invaluable. Another aspect important to field use is the effect on timing caused by the orientation of the Pencil during its operation and the effect due to the type of crushing. Both of these effects can be considerable, particularly at the shorter timings, because of the unsymmetrical position of the tension wire within the reaction chamber. MRL Report No. 120 records an exhaustive study of these effects and resulted in recommendations for the handling of the Mark I Pencil which were transmitted to the field.

Contract: OEMsr-955 with [redacted] official investigator.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Final Report: No summarizing report of the MRL work on this subject was issued; however, the list of MRL reports at the back of this volume gives the numbers of all reports concerned with the Mark I Pencil.

Patent Report: No inventions were made.

Part V: Mark II Pencil

Historical Background

The known deficiencies of the Mark I Pencil, even in its improved form SRA-3, were apparent to all. British workers at the SOE stations in England had grappled with the problem of developing a substitute and improved Pencil and continued to do so throughout the war. Their development took the form at the start of a plastic Pencil which differed very little in over-all principle from the Mark I. It did not, therefore, tend to correct the notable deficiencies in temperature sensitivity and reproducibility.

The [redacted] contract had been initiated in January 1943 with the thought that an entirely new delay might be developed which would overcome these two major difficulties. The requirement for such a delay was considered urgent, and the Services expressed willingness to take any device which might come forth so long as it was mechanical in operation, small, and simple to manipulate. (b)(3) NatSecAct

The [redacted] group, during the first year of its existence, made a number of false starts toward the solution of this problem. These included the X-ray delay based on the corrosion of the magnesium alloy, lead creep and zinc creep delays based on the cold flow of these metals, and electro-mechanical delays. Two of these appeared sufficiently promising to warrant a decision on the part of the Service representatives, and this was obtained at an MRL conference on March 27, 1944. At that time the X-ray delay was presented and its scope indicated. It was decided that while it was remarkably small and easy to manufacture, nevertheless it did not approach the solution of the Mark II problem. Also presented at this meeting was the electro-mechanical work which at that time had reached the stage of a delay designed on the principle of two bucking cells. The delay was achieved by the erosion of a zinc wire constituting the negative pole of an add-water battery which had for its positive electrode a silver wire coated with silver bromide. Two of these cells so arranged as to buck each other and having unequal quantities of zinc could be expected to supply current sufficient to fire an electric squib from one upon the exhaustion of the other. The group meeting at MRL decided that this line was the one most likely to succeed, and work was therefore pressed by the [redacted] Company on the electro-mechanical delay. (b)(3) NatSecAct (b)(3) NatSecAct

Unfortunately this earliest design on further examination turned out very poorly and was soon abandoned in favor of a design which utilized a number of the parts of the Mark I Pencil but incorporated also the principle of the add-water cell. The earliest conception of this device which later became the Mark II Pencil was in May 1944, when the group under Dr. [redacted] conducted a number of tests using the Mark I Pencil parts in the (b)(3) CIAAct (b)(6)

main but substituting for the copper chloride solution an ammonium chloride solution and providin., an insulated cell in the Pencil end. This [redacted] (b)(3) NatSecAct cell consisted of the iron tension wire of the Pencil, a silver silver chloride electrode, a plug of cotton to absorb the electrolyte on crushing the ampoule, and a resistance wire connecting the two cell electrodes.

The operation of this device was based on the principle that the discharge of the battery $Fe/NH_4Cl/AgCl/Ag$ results in the erosion of iron and the reduction of silver chloride to silver. The time produced, if the cell were perfectly insulated, would depend on the internal resistance of the cell and on the external resistance connecting the iron and silver electrodes. Since the internal resistance is large, this system was capable of providing a delay period up to about 24 hours, and the delay desired could be controlled at will by variation of the connecting resistor.

The first trials of this design were remarkably reproducible, the percent variance being about 8 in contrast to the Mark I Pencil which seldom fell below 20. So promising did the matter appear that the Pencil Research Committee established a subcommittee to follow it and the work going on at the (b)(3) NatSecAct [redacted] on organic fibers. This group, representing OSS, SOE, NDRC, and the respective contractors, first met on January 24, 1944, at which time various decisions were reached regarding the design. It was decided that the over-all dimensions of the Mark II should be identical with the Mark I if possible, that the different colors should give the same mean timings as the Mark I, that each color would be achieved by a separate non-adjustable resistance, and that the iron wire should be 10 mils instead of 21 and should be electro-galvanized instead of tinned.

With the substitution of a smaller wire, the springs previously used in the Mark I had to be abandoned. These springs in that Pencil were loaded to 15 pounds, but in the Mark II this was too great a load for the smaller wire. A new spring was accordingly substituted, loaded to 10-3/4 pounds and by MRL tests was shown to be satisfactory (MRL Reports No. 57 of March 4, 1944, and No. 142 of September 22, 1944).

At the July meeting of the Subcommittee, [redacted] was requeste (b)(3) NatSecAct to prepare a number of samples and to determine the time temperature characteristics. Unfortunately, difficulties appeared. It was soon found that the ammonium chloride solution was not suitable, since it reacted slowly with the copper of the crushable copper tube. A change in the longer timings was therefore made to a 20-percent calcium chloride solution containing 0.01 percent Aerosol. [redacted] (b)(3) NatSecAct

During the succeeding two months [redacted] using this improve (b)(3) NatSecAct model, conducted a number of tests at -10°, +25°, and +60° C. These confirmed the theoretical belief that the electro-chemical design would be one

which would be insensitive to temperature change, for the Mark II Pencil depended on Ohm's and Faraday's Laws in which temperature does not enter. This was in contrast to the Mark I Pencil which was a combination of electro-chemical and chemical reactions and because the latter was the largest contributing factor, was as sensitive to temperature change as are most chemical reactions.

With these favorable preliminary results, Division 19 called a meeting of all interested parties. This took place on November 1, 1944, and was attended by representatives of OSS, SOE, the Corps of Engineers, and the interested contractors. The Mark I and Mark II Pencils were compared, data was presented showing the time and temperature characteristics of both and the reproducibility. At the same time it was pointed out that the Mark II because of its unsymmetric design, required initiation in the vertical position with the cell end down to allow the electrolyte liberated from the crushed ampoule to be soaked up by the cotton wad. The Services received the development with enthusiasm, and accordingly arrangements were approved for the [redacted] (b)(3) NatSecAct

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

It was at this time that a second British development leading to a possible Mark II time delay came to a similar stage. This device was the development of [redacted] (see British reports of June 7 and October 14, 1944, on "Disc Time Delay"). It depended upon the diffusion of atmospheric gases through a ceramic plug into an evacuated chamber having in its end a click diaphragm similar to that used in the Sympathetic Fuze. Because the diffusion of gas is little affected by ordinary temperature changes, this device was expected to eliminate completely the temperature difficulty of the Mark I. It was not clear, however, that the ceramic plugs could be reproducibly constructed on a large scale, and it was certain that such a delay would be far more expensive to manufacture and would require 100 percent inspection and testing. A semi-production in England of this device ran concurrently with the Mark II Pencil. It did not reach a successful conclusion for the reasons given above.

(b)(3) NatSecAct

Following decision to produce [redacted] Mark II Pencils, the [redacted] Company, at the suggestion of the Pencil Committee, negotiated a purchase order with [redacted] who at that time were producers of the SRA-3 for OSS. In early December [redacted] agreed to undertake the assembly job with the exception of winding the resistors, and this task was assumed by [redacted] in Philadelphia, also under purchase order from [redacted]

(b)(3) NatSecAct
(b)(3) NatSecAct

The production which then began was attended by more than the usual number of complications and difficulties, and it was only through the persistence and remarkable energy of [redacted] that the final units of the [redacted] reached the interested Services in May 1945. The first production run, by agreement of OSS, SOE, and NDRC, was sent to MIL so that tests might begin at once on the initiation procedure required for the Mark II, and it was at this time that OSS began to raise objections, claiming that the requirement

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct

of vertical initiation was too difficult for an operator to learn. The report of MRL in April showed that initiation was a very simple process, but the Service objections were never fully overcome.

On May 7, 1945, the final meeting of the Subcommittee took place, at which time the liaison officers were acquainted with the details of semi-production, were given the samples which they had requested and copies of the MRL report on the subject (Report No. 203 of May 4, 1945). Confirmatory tests by the Engineer Board were reported September 13, 1945, with recommendations that the Board continue development to eliminate the positional feature which they considered serious.

It is probable that had the war continued OSS and SOE would have gone into a limited production. As it was, May 1945 found both of their organizations in an advanced state of demobilization. Accordingly, the Mark II Pencil was never produced or sent to the field. This was a disappointment to the Division and MRL representatives, who were assured by the large mass of evidence accumulated that a time delay vastly superior to the Mark I in both temperature coefficient and reproducibility had been developed and shown to be simple and cheap to produce.

One last item deserves mention under this heading. This was the development at MRL of a delayed-action arming device for use with the air-activated Sympathetic Fuze (SAC-10). This simple, reliable gadget was based on the principle of the Mark II Pencil and was improved by being independent of position, while still retaining the characteristically low temperature coefficient and reproducibility. It also reached fruition at too late a stage (MRL Report No. 230 of July 26, 1945).

Technical Information

1. Theory.

The Mark II Pencil utilizes the disappearance of metal from the negative electrode of a cell during discharge. This disappearance is transmitted mechanically to effect firing of the delay. The Laws of Faraday express the correlation of electricity which passes and the amount of chemical substance undergoing change at the electrodes. The rate of discharge is varied by modifying the value of the current in the circuit and may be accomplished by changing the value of resistance in the external circuit. Therefore the time of discharge is predeterminable if a substance supplying the electro-chemical reaction and the current is of controlled value. Two observations are noteworthy: first, reproducibility of timing is good at constant temperature; and second, the change in time of discharge for a large change in temperature is relatively small. It should be stated, however, that the effect of temperature increases as the ratio of external resistance to the internal resistance of the cell decreases.

2. Description of Mark II.

The chief difference between the Mark II and the Mark I Pencils is the substitution at the bottom end (for the screw fastening of the Mark I) of a [redacted] cell body having a recess containing cotton packing, through which pass the iron wire which is the tension member and a silver-silver chloride electrode. The latter two are connected by a soldered resistance wire which varies in value for the different colors. In order to preserve the over-all dimensions of the Mark I, the crushable copper tube connecting this cell with the body of the Pencil is shorter and the ampoule contained therein is likewise smaller and contains 0.23 cc of electrolyte rather than the 0.65 specified for the Mark I. As has been said already, the iron tension wire is smaller and under only 10-3/4 lb. tension supplied by the spring. (b)(3) NatSecAct

3. Individual Parts.

(b)(3) NatSecAct

[redacted]

4. Comparison with the SRA-3.

The Mark II weighs 18.28 g. compared with 19.65 g. Its performance can be seen from the following tables, which speak for themselves.

TABLE I

Color	Nominal Delay Time in Minutes	Ratio of Time at -12° C. to Time at 25° C. SRA-3	Mark II, Model 3
Black	10	82	2.5
Red	22	3.1	1.7
White	79	14	1.2
Green	190	21	1.4
Yellow	390	32	1.4
Blue	870	39	1.3

It is important also to compare values of σ', or rather the percent variance, the latter being independent of the actual timing range. The smaller the values of this function, the higher the precision of time. Again the comparison is to the advantage of the Mark I.

TABLE II

Color	Nominal Delay Time in Minutes	Value of $\frac{100\,\sigma'}{X}$ Percent — SRA-3 25° C.	SRA-3 -12° C.	Mark II 25° C.	Mark II -12° C.
Black	10	13	78	9	11
Red	22	13	27	10	13
White	79	19	17	8	11
Green	190	15	16	9	9
Yellow	390	15	16	9	9
Blue	870	20	17	10	7

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Contract: OEMsr-876 with [redacted]

(b)(3) CIAAct
(b)(6)

[redacted], official investigators; January 11, 1943, to July 15, 1945.

Final Report: Division 19 Serial No. 31, Part V, sent to [redacted] on July 15, 1945.

(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded to Captain [redacted] on August 14, 1945.

(b)(3) CIAAct
(b)(6)

(b)(3) NatSecAct

Part VI: Magnesium Alloy Delays

Under SAC-11 a full discussion of delays based on the use of a readily corrodible magnesium alloy has been presented. Several designs are there described, of which only one known as X-ray reached the stage of full development. Its chief advantage lay in its smallness and it was always felt to be offset for general use by its inaccuracy and temperature sensitivity. The delay was also not capable of development to cover the full time range required for a useful device.

Part VII: AC Delay

Historical Background

A very successful British delay based on the principle of softening of a celluloid disc by acetone and known as the AC Delay was used extensively by them in Limpetry. Later when American production of Limpets began, an accompanying demand for American produced AC delays arose, and OSS in July 1943 proceeded to place the necessary orders.

[redacted] (b)(3) NatSecAct

In early December 1943 the first of the OSS production arrived at MRL for test. In general it appeared satisfactory. The celluloid disc problem had been eliminated by the use of celluloid supplied from Britain, but the question of solvents still remained, and particularly in the case of the blue delay which utilized amyl acetate. While the production of the Mark I AC Delay continued, the British attempted the development of two further modifications known as the Mark II and the Mark III, where the celluloid disc was replaced by a celluloid rod under tension. A similar program was never initiated in this country. However, two problems were presented by OSS which called for modification of the Mark I.

(b)(3) CIAAct (b)(6) The first of these was received in February 1944, when OSS Schools and Training desired the development of AC Delays having a timing range up to 30 days. [redacted] of MRL assumed responsibility for the problem and successfully solved it. This he did by the introduction of three new ampoule solutions (violet, black, and gray) based on new organic solvents. (See MRL Report No. 123 of August 18, 1944). Specifications were drawn by OSS, and procurement of 1000 of each color was undertaken. These were found suitable (MRL Report No. 207 of May 16, 1945), although the effect of position of the delay during its action was found to exist with erratic results obtained when the delay was standing on end.

The second problem appeared in June 1944, when Schools and Training and the Maritime Unit of OSS desired for training purposes the development of a short (5 to 30 minute) reloadable delay. [redacted] proceeded to the (b)(3) CIAAct (b)(6) solution of this problem by the use of methyl formate and the design of a new molded disc to replace the celluloid one. In the latter activity he

(b)(3) NatSecAct

was assisted by the Plastic Division of the [redacted], who supplied a number of plastics for trial, and by the Naval Ordnance Laboratory of Silver Springs, Maryland, who were authorized to construct the project mold and prepare the necessary perforated discs. The final report on this development (MRL Report No. 186 of March 19, 1945) indicated a satisfactory solution, and a small production was later undertaken by OSS and used for the intended purpose (MRL Report No. 205 of May 11, 1945).

Throughout this period the MRL group assisted the New York Procurement Office of OSS in the testing and approval of the Mark I production. This served to indicate that the American production equalled the British production (MRL Report No. 108 of July 13, 1944, and No. 159 of November 14, 1944, and No. 187 of March 26, 1945). The only point not clarified was a suitable American source of celluloid (MRL Report No. 122 of August 17, 1944, and No. 109 of July 20, 1944), although it was recommended that should British celluloid be unavailable American Butacite be substituted.

Lastly, in connection with the Sleeping Beauty (see SAC-4) it was desired to demonstrate that the AC would withstand immersion to considerable depths (70 feet). This was shown satisfactorily in Report No. 212 of June 1, 1945.

Contract: OEMsr-955 with [redacted] official investigator.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Final Reports: MRL Report No. 186 of March 26, 1945, Mark I AC Delays.
MRL Report No. 207 of March 16, 1945, Long-time Delays.
MRL Report No. 205 of May 11, 1945, Short-time Delays.

Patent Report: Forwarded to Captain [redacted] on April 11, 1945.

(b)(3) CIAAct
(b)(6)

Approved for Release: 2018/06/04 C03126390

[redacted]

Part VIII: Clockwork

Historical Background

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

One of the oldest problems of Division 19 was the development of a clockwork delay. The work done [redacted] has already been touched upon. It did not result in a suitable device. In January 1943, when the first contact was made with the [redacted] (b)(3) NatSecAct Company, all previous work on time delays of all types was disclosed. This included the Chicago work.

Because it was known that the Engineer Board at Fort Belvoir, Virginia, had three different clock manufacturers under contract to develop clockwork (b)(3) CIAAct delays, no particular impetus was given to the contractor until late i (b)(3) NatSecAct February, when OSS, SOE, and Division 19 representatives gathered in Philadelphia and presented [redacted] (b)(6) [redacted] samples of the devices then available. At the same time requirements were framed for the development of a delay suitable for use with the Limpet. In addition, mechanical firing was specified, and it was hoped that this could be centrically designed. At the same time a contact was made with [redacted] and during March his interest and cooperation was secured.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

At a large meeting in April attended by the [redacted] Deputy (b)(3) CIAAct Head of IS&B, and [redacted] definite requirements were (b)(6) framed for a clockwork device. These included the specification that it should be insensitive to temperature change, vibration, magnetic field, shock, and immersion. In addition, it was pointed out that it should be based on a cheap watch movement to allow large production. In this meeting [redacted] (b)(3) CIAAct showed for the first time a prototype of the mechanical system he proposed (b)(6) to use in conjunction with a watch movement. This differed materially from the early [redacted] design utilizing an [redacted] watch. The central firing feature was not preserved and seemed to be a small sacrifice for convenience and speed.

(b)(3) NatSecAct
(b)(3) CIAAct
(b)(6)

By June [redacted] had constructed in his shop the first 12-hour model based on a [redacted] movement and capable of a 5-minute setting accuracy by retention of the minute hand. This model underwent tests during the following weeks, and in June appeared so favorable that the Division decided upon a semi-production. At their request the Engineering and Transition Office proposed as contractor [redacted] (SAC-27). The negotiations with [redacted] dragged, however, and eventually OSS felt itself in a position to begin its own procurement. [redacted] thereupon located the [redacted] located near at hand in Philadelphia. New specifications were prepared, and an OSS contract for [redacted] models was forthcoming.

(b)(3) NatSecAct
(b)(3) NatSecAct
(b)(3) NatSecAct
(b)(3) NatSecAct

Meanwhile, the British at [redacted] had continued the development (b)(3) NatSecAct of a central firing unit based on the [redacted] then used in British aircraft. This device was very cumbersome, large, and sensitive to shock. It did not survive the extended test program, and eventually SOE accepted the [redacted] device as a store. (b)(3) NatSecAct

At almost the time when OSS began its contract, the DOLO Committee became aware of the development and brought it to the attention of the Navy for use of the Underwater Obstacles group. The acceptance of it by the Navy was immediate and startling: six thousand units were requested for delivery in two months. OSS and the Navy thereupon came to an understanding, by which the Navy took over the procurement contract and agreed to supply OSS and SOE with their much smaller requirements. The Bureau of Ordnance made a few minor changes in the [redacted] design, only one of which (b)(3) NatSecAct later turned out to be serious. This was the modification of the stiff dial which replaced the hour hand by a thin disc. This modification later was abandoned and the original design readopted (designated Firing Device, Mark III).

From November 1943 to December 1944 the [redacted] acted (b)(3) NatSecAct as consultants to the [redacted] contract. This function was of the greatest value and convenience. In April 1944 [redacted] (b)(3) CIAAct was so disturbed by the lack of Navy inspection and so fearful that serious (b)(6) trouble might therefore arise that a meeting was held with the Philadelphia Naval Inspection Board with the interested parties in attendance. The Navy accepted all the [redacted] suggestions for correction, (b)(3) NatSecAct and in addition re-inspected all the units which had been made. This confirmed [redacted] statements and the entire production, numbering several (b)(3) CIAAct thousand units which had been made up to that time, was returned to the (b)(6) manufacturer for reconditioning. MRL tested the 12-hour delay also with on the whole, more favorable results (MRL Report No. 80 of May 4, 1944, and No. 80A of August 2, 1944).

Meanwhile, [redacted] had also been working on the development of a 24-hour (b)(3) CIAAct model which he completed in June, when ten models were received by the Division and distributed to the interested Services. (b)(6) The 24-hour model was identical with the 12-hour model in all respects except for the gearing of the New Haven movement. Appraisal of it by OSS and the Navy resulted in a small procurement on their part.

In July the existence of very small 8-day movements used in Naval aircraft came to the attention of the Division, and it was thought that these might be small enough to fit the case of the 12-hour and 24-hour delays. Mr. [redacted] proceeded during the following months to show that this was possible, (b)(3) CIAAct and in August 1945 two models were received. (b)(6) These aroused the interest of the Engineers and OSS, but since their arrival coincided with V-J Day, no production took place.

MRL throughout the program was always of assistance in testing the different models. Their results obtained with the 24-hour production confirmed their

earlier ones obtained with the 12-hour (NRL Report No. 193 of April 9, 1945, and No. 211 of May 30, 1945). Their conclusion was that both devices were "water-tight, rugged, not impaired by either a magnetic field or severe vibration, and capable of operating satisfactorily under all probable climatic conditions."

(b)(3) NatSecAct

(b)(3) NatSecAct

The 12-hour model was produced in large numbers [redacted] and of the 24-hour device [redacted] were manufactured. The OSS and SOE use for either type was not limited to Limpets. Wherever an exact timing of an explosion was required this special time delay was available. In contrast to the Pencil it was never intended as a general issue item but was reserved for special operations. The Navy use was in connection with the detonation of underwater explosive charges placed by the Underwater Demolition groups which trained at Fort Pierce, Florida, and later performed such spectacular services in the Southwest Pacific.

Technical Information

(b)(3) NatSecAct

[redacted]

[redacted]

(b)(3) NatSecAct

Contract: OEMsr-876 with [redacted] and [redacted] official investigators; January 11, 1943, to July 15, 1945.

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(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Final Report: Division 19 Serial No. 31, Section 2, of July 15, 1945, submitted to [redacted] on September 7, 1945.

(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded to Captain [redacted] on August 14, 1945.

(b)(3) CIAAct
(b)(6)

Approved for Release: 2018/06/04 C03126390

(b)(3) NatSecAct

[redacted]

Approved for Release: 2018/06/04 C03126390

SAC-18 EMILY POST

Operational Background and General Statement of the Problem

Mr. Lovell desired the development and release to him of systemic reagents capable by choice of producing in the victim anaesthesia or sudden death. It was said that such materials would be of value to special agents under special circumstances in the gathering of intelligence or in facilitating their escape.

Historical Background

Work on subtle and highly poisonous chemicals had been undertaken by Section 9.1-2 late in 1943. Included was a study of synthetic organic substances and of natural agents such as W and V. The OSS request amounted to a desire for the results of this program. [redacted] however, on reviewing the problem as originally submitted, did not feel that it was one which he could accept and a reply was made to Mr. Lovell suggesting that he secure the cooperation of CWS, who had complete liaison with the Division 9 work on the subject. Mr. Lovell acted in February 1944 upon [redacted] suggestion and secured permission from Major General William N. Porter, Chief of CWS, for Major A. G. Noble of his office to have access to all information which he might desire. On the basis of this letter, [redacted] and [redacted] felt free to release to Major Noble and OSS the details of the NDRC program. [redacted] who had been Technical Aide for Section 9.1-2, was asked to make the necessary arrangements, and liaison was set up in March.

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(b)(3) CIAAct
(b)(6)

During the ensuing year, Major Noble was in direct contact with both Divisions 9 and 10 and received from them all technical information of this sort for which he had need.

Problem Submitted: January 1, 1943. **Problem Declined:** February 6, 1943.

Problem Reopened: February 16, 1944. **Problem Terminated:** June 30, 1944.

Contracts: None.

SAC-19 PASTE

Operational Background

Throughout British operations particularly, and OSS to a lesser degree, the use of plastic explosives was very common. Specifically mentioned as examples are Limnatry (SAC-42) and Casey Jones (SAC-10). It was feared [redacted] that the supply available to these two organizations would not be sufficient to cover their demands, and accordingly he expressed interest in the development of a substitute plastic explosive not based upon RDX. It was suggested that PETN would serve as a suitable base.

(b)(3) CIAAct
(b)(6)

General Statement of the Problem

The assistance of Division 19 was requested in studying, evaluating, and producing a quantity of such a plastic PETN. The problem was accepted on the understanding that Division 8 would cooperate.

Historical Background

All the work on this problem was done by Division 8 in the Explosives Research Laboratory at Bruceton, Pennsylvania, and in fact was already in progress when the OSS request was received. The original solution to the problem known as PEP was presented in June of 1943 but on aging tests was found to be unsatisfactory due to hardening and loss of workability. By September 1943 a second composition known as PEP-2 had been developed and in this these faults were corrected. [redacted]

(b)(3) NatSecAct

In October [redacted] prepared 1000 pounds of PEP-2 under a subcontract with the Bruceton Laboratory. The bulk of it was sent to the Engineer Board at Fort Belvoir for test, but 50 pounds were secured for OSS tests, these being conducted in January 1944 at MRL under the direction of Captain John Jeffries (MRL Report No. 37). A summary of Division 8's work on the subject was issued as OSRD 3240 on February 11, 1944, and with the forwarding of a copy to Mr. Lovell the problem was considered satisfactorily concluded.

(b)(3) NatSecAct

(b)(3) NatSecAct

[redacted]

Problem Submitted: April 19, 1943. **Problem Terminated:** March 3, 1944.

Contract: All work was done under Division 8 contract OEMsr-202 with (b)(3) NatSecAct [redacted] There was no transfer of funds, since the work was being carried on anyway under Service Directive OD-04.

Final Report: OSRD No. 3240 from the [redacted] (b)(3) NatSecAct Bruceton, Pennsylvania, dated February 11, 1944.

Patent Report: No patent report was involved since it was not a Division 19 contract.

Classification: Secret to Confidential

SAC-20 BLACKOUT

Operational Background

In many regions where OSS operators were at work it was said that lighting was of a primitive sort common in this country about 1915. The picture was drawn of a bare room having a single light bulb hanging from a cord in the center and operated at the bulb. It was thought desirable to develop an explosive bulb which could be surreptitiously substituted for the real bulb in an enemy's room and with which he would innocently commit suicide.

General Statement of the Problem

It was desired that the Division develop [redacted] for the above purpose [redacted] (b)(3) NatSecAct

Historical Background

An approach in April 1943 [redacted] resulted in their supplying sample bulbs [redacted] These, together with the general problem, were placed before Dr. G. B. Kistiakowsky for his opinion. This was so forcefully given and so completely negative that the problem was terminated at once. (b)(3) NatSecAct

Technical Information

A quotation from Dr. Kistiakowsky's opinion will support the decision:

[redacted] (b)(3) NatSecAct

Problem Submitted: April 19, 1943. **Problem Terminated:** May 30, 1943.

Contract: None.

SAC-21 FIREFLY

Operational Background

The importance of attacking motor transport is obvious, and a general problem on this subject has already been discussed under SAC-9. At the time when this problem originated, the Germans had extended communication and supply lines across Poland to the Russian front. It was understood that a large part of their military requirements were carried in truck convoys and the need for attacking these was great. SOE had organised resistance groups throughout Poland, and it was their hope to place in the hands of these men simple devices which could be counted upon to destroy the motor vehicles. While the gadget developed under this problem was eventually produced in very large quantity by OSS, it did not actually reach the theater in time for use as originally intended. It did, however, function well in France and Yugoslavia just prior to and subsequent to D-Day and was considered a valuable addition to the arsenals of the underground.

General Statement of the Problem

(b)(3) NatSecAct

[redacted]

(b)(3) CIAAct
(b)(6)

Historical Background

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Prior to formal receipt of the problem, [redacted] had presented the idea [redacted] This was in January 1943, and as a result [redacted] pany had proceeded to devise a breadboard model which in simulated fuel tanks behaved in the desired manner. This early work was done under a contract which Division 11 had with SOD (OEMsr-354).

(b)(3) CIAAct
(b)(6)

Considerable int ivision 11 arranged a demonstration at Camp Smith in Peekskill, N. Y., in which derelict automobiles were attacked with Fireflies both in motion and while standing still. Very satisfactory results were obtained and the field was littered with burned out hulks. This demonstration was a cooperative enterprise in which the [redacted] provided the vehicles under Contract OEMsr-896.

So well satisfied were OSS and SOE with the results of this test that it was decided to proceed with an NDRC semi-production of approximately 1000 units. Accordingly, a separate Division 19 contract was initiated with the [redacted] (OEMsr-997). The models produced up to that time had been entirely handmade from brass; it was proposed that the semi-production models should be more representative of standard manufacturing procedures. A number of dies were cut so that most of the parts could be made from [redacted] and details of loading and assembly were worked out by SOD. Throughout the program the assistance of Picatinny Arsenal was provided [redacted]

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(b)(3) NatSecAct

[redacted]

Technical Information

(b)(3) NatSecAct

[redacted]

[redacted]

Problem Submitted: April 19, 1943. **Problem Terminated:** July 6, 1944.

Contracts: OEMsr-354 [redacted] This Division 11 contract covered the work from January to May 1, 1943, when Contract OEMsr-997 with [redacted] was negotiated by Division 19. [redacted] official investigator; May 1, 1943, to December 31, 1944.

OEMsr-572 with [redacted] official investigator; July 1, 1942, to June 30, 1943.

Final Reports: OEMsr-354: This contract was a Division 11 contract and the work done on the Firefly was a small part of it; it is fully described in a report dated March 11, 1943.

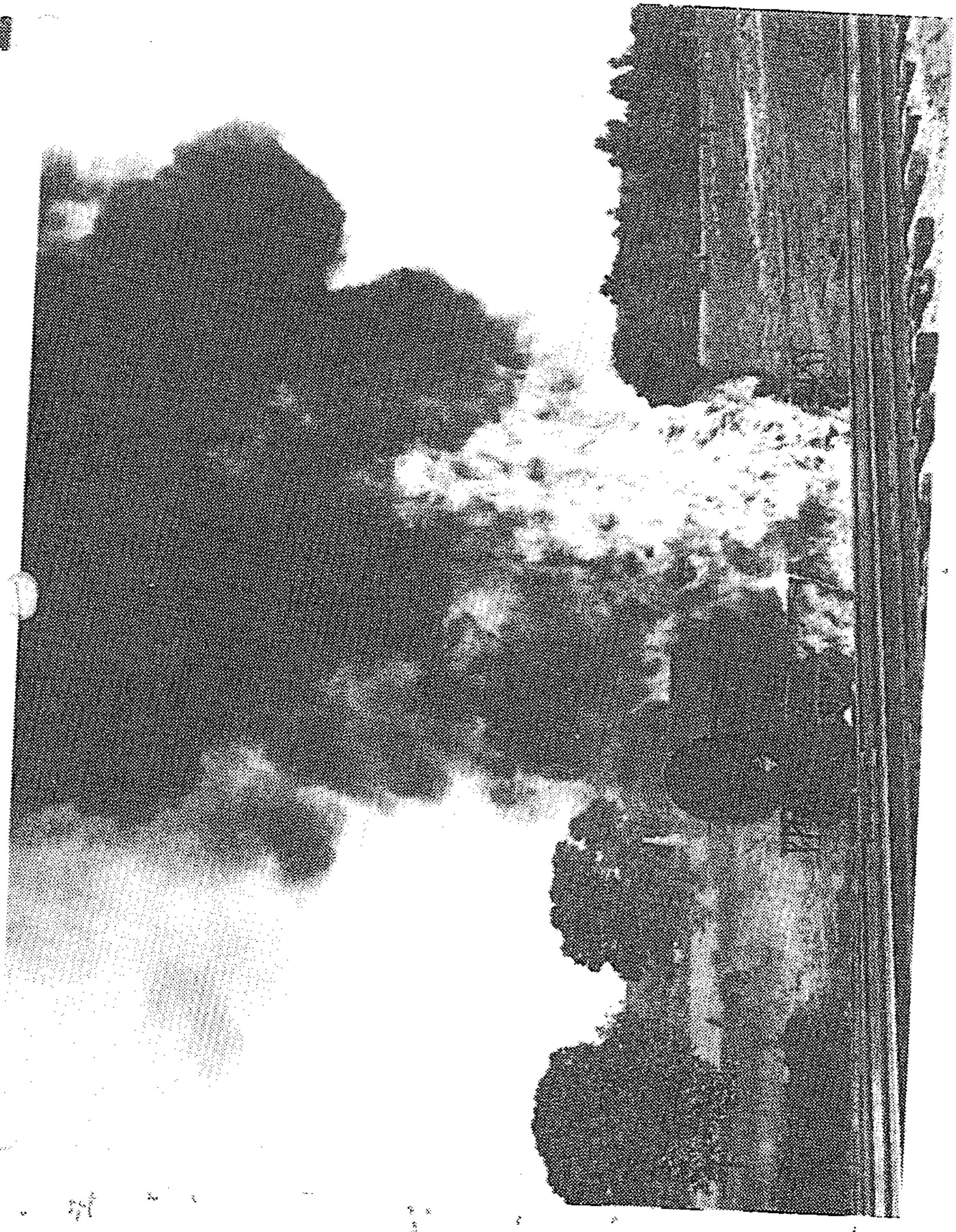
OEMsr-572: The final report on the expanding plug, dated January 26, 1944, was submitted to [redacted] on January 26, 1944.

OEMsr-997: Division 19 Serial No. 6 was submitted to [redacted] on May 1, 1944.

Patent Reports: On April 25, 1944, invention reports were submitted to Captain [redacted] covering all the [redacted] work under both contracts. The final clearance of OEMsr-572 was sent by [redacted] to Captain [redacted] on February 19, 1945. Invention report on the Expanding Plug developed under OEMsr-572 was forwarded to Captain [redacted] on January 16, 1945.

(b)(3) NatSecAct

[redacted]



SAC-22 AND SAC-24 POSTEL AND PEP

Operational Background

OSS and SOE operations were frequently of an intelligence nature and resulted in an agent's being located behind enemy lines or across enemy frontiers with the necessity of communication with a home base or other intelligence stations. When this problem was first posed to the Division, most of the operational work was being done in Europe where there were extensive links of a more or less permanent nature such as power lines, telephone lines, railroad tracks, pipe lines, etc., and it was desired that these permanent installations should be used for the transmission of intelligence without the knowledge or interception of the enemy.

General Statement of the Problem

Two problems were submitted which covered the general subject: SAC-22, which requested the use of telephone cables or lines without danger of being overheard by parties already using these lines; and SAC-24, which suggested that electrical power systems could be used for communication within the system. Since these two problems were essentially one, namely communication across frontiers, they were handled together and were extended in their scope by an OSS request for an evaluation of radio signaling for the same purpose. It is noted that this work was different in viewpoint from earlier British work reported in November of 1942 and concerned chiefly with intercepting and amplifying signals already passing over telephone and cable lines.

(b)(3) CIAAct
(b)(6)

Historical Background

(b)(3) CIAAct
(b)(6)

(b)(3) NatSecAct

(b)(3) NatSecAct

(b)(3) CIAAct
(b)(6)

(b)(3) NatSecAct

(b)(3) NatSecAct

(b)(3) CIAAct
(b)(6)

The problem was handled within Division 19 by [redacted] who arranged for a meeting in August of 1943 of representatives of the [redacted] of SOE and [redacted] of OSS with the object of beginning a survey by the [redacted] of existing data and equipment which might fulfill the requirements. [redacted] at the same time presented the problem to [redacted] Chief of Division 13, and the work was from that time on handled entirely from a technical viewpoint by Section 13.4, who initiated a contract with the [redacted] effective August 1, 1943. In general, liaison was maintained directly between the [redacted] and [redacted] representing OSS, and Major [redacted] and [redacted] representing SOE.

At the organizational meeting in August 1943, it was decided that low-power radio transmission offered the most favorable point of attack on the general problem, since it was believed that existing sets could be adapted to this type of usage. It was at first hoped to utilize ground transmission, but experiments during October indicated that this was inferior to sky wave transmission, and accordingly from November on work was concentrated on the latter technique.

[redacted]

(b)(3) NatSecAct

From this time to the middle of June, when the problem was finally terminated by the SACOM Committee, the contractor was occupied in preparing final reports and in counseling OSS on details of the sky wave transmission.

Technical Information

1. Radio Communication - Sky Wave.

(b)(3) NatSecAct

Using as an antenna an insulated wire laid on the ground having a length of [redacted] (when F is the frequency in megacycles in the range of 2 to 7 megacycles), good transmission may be obtained over distances up to at least 200 miles. The on-ground antenna has a better ratio of received signal to atmospheric noise than ordinary verticle antennas and therefore allows the use of low-power transmitters. Signaling is by CW telegraph, and the receiving set employed has high gain, low internal noise, and good selectivity. The chief difficulty lies in the choice of the proper frequency for the particular time and sending location. In general very little effect is found due to surrounding terrain, although it is believed that in the tropics somewhat higher power would be required because of the general background noise. The inconspicuous antenna and the difficulty of direction finding on weak, high angle sky wave field strength are most advantageous from the security viewpoint. Using such a system, it was demonstrated by tests with a mobile receiver that stations located in New Jersey could be received without difficulty throughout Pennsylvania.

The importance of frequency choice [illegible] fact that if frequency is too high it will pass through the ionosphere and not be reflected back to the earth, while if it is too low excessive absorption losses will occur. In general tests and theory indicate a preference for approximately 3.2 megacycles.

"It is evident that this method of transmission does not offer any absolute security against detection by enemy personnel. It does have advantages, however, stemming from the low radiation fields that increase the difficulty of detection if the signal is noticed. These advantages are increased by the careful choice of operating frequencies, times and places of operation, and by using no more power than necessary at a particular time."

Direction finding, while possible, is difficult and is further prevented by the general noise level. It should be mentioned, however, that it is relatively easy to jam signals of the type described. The preventative is to avoid its being noticed by the enemy.

2. <u>Telephone Facility Communication.</u>

[redacted]

(b)(3) NatSecAct

b. <u>Carrier Frequency Signaling.</u>

In this case no connection need be established between the individual telephones which are to be used for communication. "Use is made of inductive coupling between circuits in subscriber and central office cables. The security of the method depends entirely upon authorities in monitoring at the carrier frequencies. The best frequency for use depends on the transmission loss and noise in the particular case and fairly large variations are to be expected, since the transmission path is not one used for ordinary telephony." It was found that the most [redacted]

(b)(3) NatSecAct

(b)(3)
NatSecAct

[redacted]

Problem Submitted: May 3, 1943; extended in scope, March 1, 1944.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Problem Terminated: July 11, 1944.

Contract: OEMsr-1183 with [redacted] official investigator; August 1, 1943, to June 30, 1944; contract handled entirely from an administrative and technical viewpoint by Section 13.4.

Final Report: Division 19 Serial No. 13 was accepted by Division 13 as fulfilling the contractor's obligations and its distribution was by Division 19.

Patent Report: Forwarded by Division 13 to Captain [redacted] on November 3, 1944; no inventions were made.

(b)(3) CIAAct
(b)(6)

 on: Secret

SAC-23 HEDY

Operational Background

As a general harassing weapon, OSS desired the development of a simple portable device which would "create the maximum panic over the largest possible area" when introduced into a crowd. The actual purpose of such a weapon would be to facilitate the escape of an agent who had accomplished some act of sabotage and wished to create a turmoil which would hide his escape.

General Statement of the Problem

The Division was asked to develop a device capable of creating panic in crowds by methods which did not countervene the Geneva Convention. Fire, odor, color were all suggested.

Historical Background

Upon receipt of this problem a contract was negotiated in May 1943 with [redacted], a firm on consulting chemists who were felt to be well suited to handle this particular problem and a number of others, all of them small and specialized in nature. Their contract, covering work on "certain strategical and psychological weapons" was a most convenient and fortunate arrangement and subsequently included a number of problems: SAC-23, SAC-23B, SAC-26, SAC-28, SAC-31, SAC-39, SAC-43, and SAC-50.

(b)(3) NatSecAct

[redacted]

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

At approximately the same time it was discovered that CWS had under development a grenade for quieting riots, and this was brought to the attention of OSS, who undertook evaluation of it. The Division and [redacted] therefore did not consider WP further and concentrated on a pyrotechnic solution to the problem.

(b)(3) NatSecAct

In June 1943 [redacted] of the [redacted] and placed the problem in his hands. During August and September demonstrations and tests took place at MRL of a number

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct

[redacted]

(b)(3) NatSecAct

[redacted] in December 1943 complete drawings and specifications were provided. OSS thereupon instituted procurement with the [redacted] being fortunate to find that that company was already producing a firework which was quite comparable.

(b)(3) NatSecAct

There followed a period of MRL testing, but by October 1944 this had been completed and the reliability of the device was certified.

Technical Information

[redacted]

(b)(3) NatSecAct

Problem Submitted: May 3, 1943. Problem Terminated: July 7, 1944.

Contract: OEMsr-1023 with [redacted] official investigator; May 24, 1943, to June 30, 1945.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Final Report: Division 19 Serial No. 22, Part I, submitted to [redacted] on October 4, 1945.

(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded to Captain [redacted] on October 15, 1945.

(b)(3) CIAAct
(b)(6)

(b)(3) NatSecAct

(b)(3)
NatSecAct

[redacted]

SAC-23B WHO, ME?

Operational Background

A very popular store which the British distributed throughout Western Europe, especially in Holland, was a tube filled with an obnoxious smelling liquid which was used by the helpless subjugated population to contaminate the persons and clothing of the occupying Germans. The device was of course of a nuisance value only, but in those dark days gave so much satisfaction to the conquered people that for morale purposes it had great value and was used quite widely. The British work in developing their device was known to OSS and to the Division, and it was hoped that perhaps an American counterpart could be developed and produced in this country for use in OSS operations.

General Statement of the Problem

The objective of the work was "to provide civilian populations with a small container holding a liquid which, squirted in very small amounts on invading troops as in a crowd, would produce very strong evidence of personal uncleanliness." At the same time it was naturally desired that the user of the device should not himself become contaminated and that the materials supplied would be as persistent as possible and not subject to removal by ordinary cleansing operations. The problem was assigned to [redacted] because of the services available there of [redacted] an authority on odors. (b)(3) CIAAct (b)(6)

(b)(3) CIAAct (b)(6)

It appeared to [redacted] that chemicals responsible for fecal odors when properly blended with vehicles to lend permanence and consistency would be the basis for a proper composition, and in December 1943 he presented the first samples for evaluation. The formula proposed followed very closely on the British formula, which was based on skatol and i-valeric acid in an oil base. A choice among a variety of variations was made and in February 1944 Who, Me? emerged as a mineral oil solution containing as active ingredients skatol, n-butyric acid, n-valeric acid, and n-caproic acid.

(b)(3) CIAAct (b)(6)

At this point it developed that it was easier to concoct a mixture of this kind than it was to package it, and the previous British experience was of no value here. [redacted] recommended the use of lead tubes having ophthalmic tips and vinylite gaskets, but when OSS procurement received the first production samples from the [redacted] they were found to leak badly, and the company claimed that it would be impossible to make a container of the kind recommended by [redacted] Accordingly, a semi-production of 500 tubes was instituted by the contractor in August 1944 with th[redacted] The work of this firm

(b)(3) NatSecAct (b)(3) CIAAct (b)(6) (b)(3) NatSecAct

proved that the device was easily manufactured if certain instructions were carefully followed and samples of their product when tested by MHL in September proved entirely satisfactory.

There was still the possibility of contamination to the user, and MHL's recommendation that a shield be mounted on the tube in back of the tip was followed and used in future production. With such an applicator it was demonstrated that a user could eject 1 cc of the Who, Me? liquid as a thin stream up to a distance of nearly 10 feet without danger of self-contamination. Unfortunately, the perfection of Who, ME? did not occur until the liberation of Western Europe was well under way, and therefore its usefulness there disappeared.

The question then arose as to whether a composition of this kind would be repellent to the Orientals, and notably to the Japanese. In discussions with experts on the subject the conclusion was reached that only two types of foulness could be counted upon as certainly objectionable: skunky odors and cadaverous odors. It was apparent that fecal odor per se is not especially obnoxious to the Japanese, and accordingly the skatol ingredient was dropped and substituted for it was skunkiness. This new preparation had "an atrocious odor with pronounced penetrating and lasting qualities." It was felt reasonably certain that it would fill all Japanese requirements. This new preparation was recommended in February 1945 and resembled the earlier one except that skatol was replaced by α-ionone. A limited OSS procurement followed, but whether the material was actually put to field use is not known.

Technical Information

"Who, Me? is a special purpose perfume of powerful and lasting skatolic (fecal) character. It contains what appears to be optimum proportions of the most effective ingredients carried in a mineral oil vehicle. It effectively and quickly contaminates the person and clothing of a recipient and should cause him to be socially ostracized for a matter of hours or even days. The finished product is in our opinion as lastingly disagreeable as a product of this kind can be. It contaminates the skin of the recipient for hours and noticeably for over a day. The odor is held by clothing even more tenaciously. It is not removable from the skin by water or by soap and water. It is removable only poorly by means of alcohol, gasoline, or other volatile solvents."

An applicator consisting of a tin or lead tube, standard with pharmaceutical houses, was found satisfactory. It has a long tip covered by a bakelite cap which is held by a gasket made of vinylite sheeting. The addition of a rubber shield of 7/8-in. diameter below the neck of the tube effectively prevents any tendency of the liquid to run back onto the user. When filled, the tube contains approximately 1 cc of perfume and is then closed by careful soldering. One kilogram of the liquid (enough for 500 tubes) has the following composition:

[redacted] (b)(3) NatSecAct

The composition recommended for Oriental use is as follows on a weight basis:

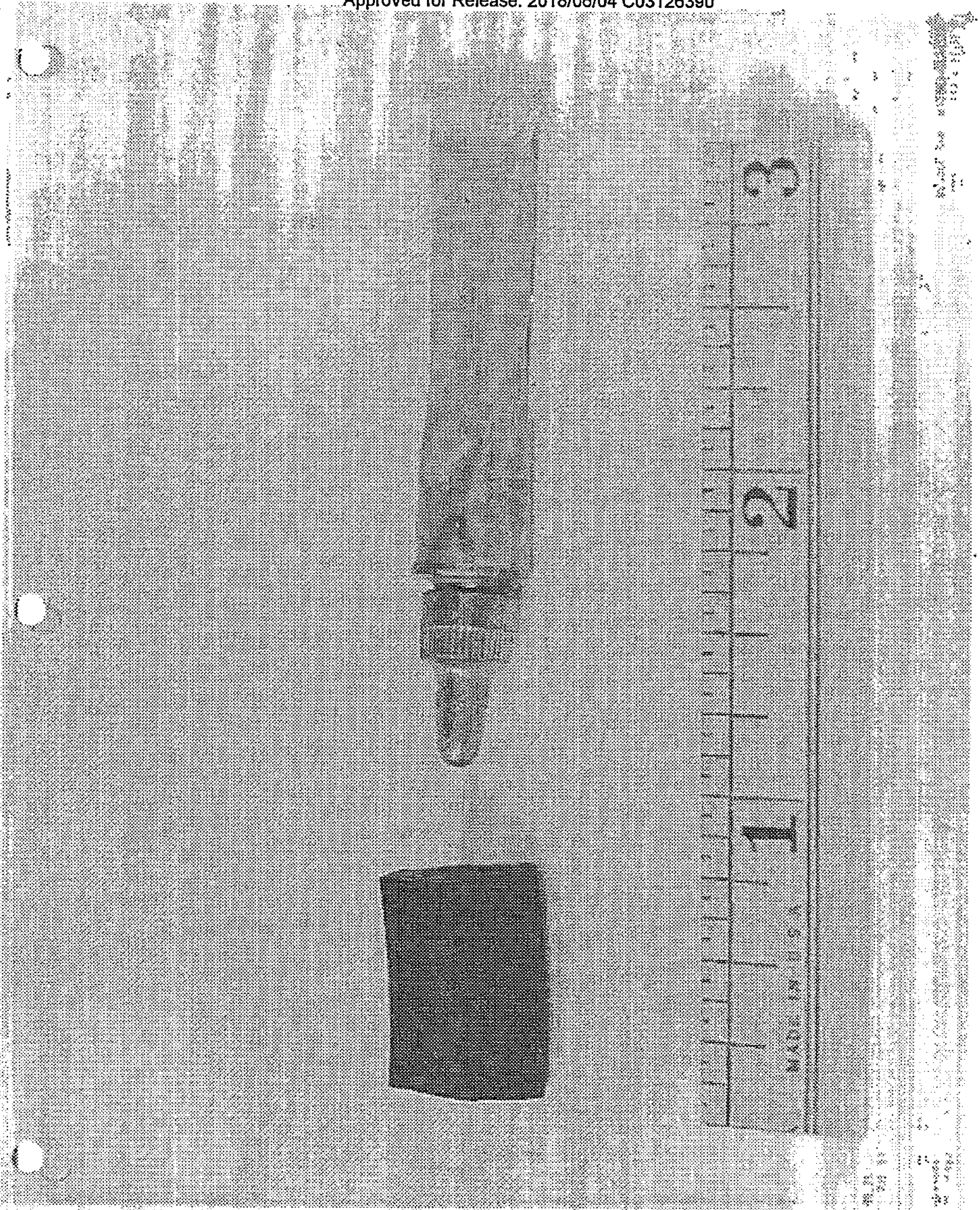
[redacted] (b)(3) NatSecAct

__Problem Submitted:__ November 20, 1943. __Problem Terminated:__ February 19, 1945.

__Contract:__ OEMsr-1023 with [redacted] (b)(3) CIAAct
official investigator; May 24, 1943, to June 30, 1945. (b)(3) NatSecAct (b)(6)

__Final Report:__ Division 19 Serial No. 22, Part VI, dated February 5, 1945, and supplement dated February 19, 1945, submitted to [redacted] on October 4, 1945. (b)(3) CIAAct (b)(6)

__Patent Report:__ Forwarded to Captain [redacted] on October 15, 1945. (b)(3) CIAAct (b)(6)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SAC-25 SHORTSTOP

Operational Background

(b)(3) CIAAct (b)(6) (b)(3) NatSecAct (b)(3) NatSecAct

The origin of this work lay in the suggestion made by [redacted] in April 1943. He proposed that electric locomotives could be attacked by the use of [redacted] It was hoped that this material when applied to communicator connections, motor brushes, insulators, transformer bushings, etc., would induce electrical leakage, arcing, overheating, and lead ultimately to failure of the electrical apparatus. The material seemed useful moreover because of its nonsuspicious appearance. Since at that time Italy was a potential field of attack and since electrical locomotives were generally used in that country, the suggestion seemed worthy of investigation, and OSS submitted a problem.

General Statement of the Problem

(b)(3) NatSecAct

As originally posed it called for the investigation [redacted] for the purpose of disabling and destroying electrical equipment. In the course of time it was extended to cover methods of sabotage for such equipment in general and a study of all materials which would lead to that end. Any discoveries would be equally applicable to the attack of electrical locomotives and the ignition systems of airplanes and motor vehicles as well as to fixed electric motors, dynamoes, engines, etc.

Historical Background

(b)(3) CIAAct (b)(6) (b)(3) NatSecAct (b)(3) NatSecAct (b)(3) NatSecAct

[redacted], who assumed charge of the work for Division 19, originally hoped to have a contract with the [redacted] but they were unable to accept this obligation, and accordingly the work was undertaken by the [redacted] in May 1943. It was not long before the group there had shown that [redacted] and similar materials were without reliable effect and the study expanded to include other chemicals with equal lack of success.

(b)(3) NatSecAct (b)(3) NatSecAct

While it was found possible to destroy electrical machines, it was not found easy to do this in a manner which would fail to arouse suspicion. In addition to direct attack, work was undertaken on the destruction of the bearings [redacted] fell very closely along the lines under investigation by the [redacted] (SAC-9) and throughout the period from August to November 1943 the two contractors cooperated in attempts along these lines.

No success was obtained, since the quantities or mixtures necessary to damage the bearings were in all cases so large as to be preposterous.

The Brooklyn group turned their attention also to radio stations, and here as well their success was limited to those cases where mechanical attack was allowable. Special tools of a very simple nature were devised which were guaranteed effectively to eliminate the shock coils, blocking condensers, and transmitter coils from operation. These same tools in general could be counted on for attack on dynamoes and electric motors; descriptive pamphlets illustrating their use were prepared. For operational reasons these were never distributed by OSS or SOE.

The contractor rediscovered [redacted] (b)(3) NatSecAct [redacted] and this so stimulated OSS that in November 1943 a formal request for work of this kind was submitted to the Division. This program was thereupon undertaken at M&L and will be found described under SAC-38.

An ever recurring suggestion, not however investigated by this contractor (b)(3) NatSecAct

[redacted]

The general conclusion of the Division and their liaison officers lead in January 1944 to the decision that further attempts at sabotage of the Shortstop kind were not promising, and the problem was concluded without any field use having been made of the work.

Technical Information

(b)(3) NatSecAct

[redacted]

[redacted]

(b)(3) NatSecAct

Problem Submitted: May 18, 1943. Problem Terminated: February 29, 1944.

Contract: OEMsr-1056 with [redacted] official investigator; May 24, 1943, to February 29, 1944.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Final Report: Division 19 Serial No. 8 submitted to [redacted] on March 17, 1944.

(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded to Captain [redacted] on March 17, 1944; no inventions were made.

(b)(3) CIAAct
(b)(6)

SAC-26 FANTASIA

Operational Background

It was claimed by psychologists within OSS that the Japanese would be terrified by an apparition appearing in the night sky over their battle lines and assuming the rough outline of a fox. Widespread and often repeated use of such a device was not contemplated, but it was thought that under appropriate conditions it might be valuable, since the Japanese would consider it as an evil omen and would respond accordingly.

General Statement of the Problem

The problem as first posed called for the simulation of a creature, preferably from ectoplasm which would float over the enemy lines at an altitude of approximately 1000 feet and would emit a dim, eerie luminescence for a period of approximately 15 minutes. It was desired that the device should disappear then without trace or when fired upon.

The problem seemed somewhat supernatural and accordingly was further clarified by a memorandum submitted by [redacted] of OSS on July 5, 1943. This stated the problem more concretely and admitted that a hydrogen-filled balloon painted with luminous paint and equipped with noise producing accessories would perhaps be satisfactory. A fox-shaped balloon barking and glowing with an inner flame seemed the desire of this OSS group.

(b)(3) CIAAct
(b)(6)

Historical Background

With clarification of the problem it was formally submitted to [redacted] N[redacted]. An approach was made by them to the [redacted] and to the Chemistry Department at [redacted] an expert in luminescence). The reaction of these groups w[redacted] exactly what would have been expected, nor were much more favorable responses obtained from representatives of firms making meteorological balloons. The only person who could be found willing to tackle the problem was a [redacted] who specialized in large-scale theatrical displays.

(b)(3)
(b)(3) CIAAct
(b)(3) NatSecAct
(b)(3) CIAAct
(b)(3) NatSecAct
(b)(3) CIAAct
(b)(6)
(b)(3) CIAAct
(b)(6)

The situation was reviewed for the benefit of Mr. Lovell, who on September 24, 1943, recommended that the problem be abandoned. "May I add that we are as delighted at this culmination as you and, I trust that this will serve as a critique to us in the field of pure reason."

Technical Information

None.

Problem Submitted: May 21, 1943. **Problem Terminated:** September 23, 1943.

Contract: [redacted] OEMsr-1023; [redacted] official investigator.

(b)(3) CIAAct
(b)(6)

Final Report: Serial No. 22, Part IV, dated February 5, 1945, submitted to [redacted] on October 4, 1945.

(b)(3) CIAAct
(b)(6)

Patent Report: No inventions were made on this part of the contract.

SAC-27 ANEROMETER

Operational Background

An obvious and rewarding way to sabotage German military effort lay in attacks on grounded aircraft. The British knew that most German machines were equipped with strategically located inspection ports, none of which was less than 2 inches in diameter. Since native personnel had access to grounded planes, it was apparent that suitable sabotage weapons in their hands would be quite effective.

The British had, accordingly, supplied to the field an electrically operated barometric switch, and this was reported to have been a factor in the retreat of Rommel from El Alamein. A light, battery-operated device--this crude switch was open to serious objections. The problem existed, therefore, to develop a better Anerometer.

General Statement of the Problem

It was suggested that an Anerometer be designed and built which would not fire on accidental dropping, could be counted upon to operate in a plane at 1500 feet above its starting elevation (sea level to 8000 feet), and would operate to fire a payload of PE of approximately 1 pound in weight. Within a few months the additional requirement was laid down [redacted] and this new requirement, together with the shock resistant feature, proved to be most difficult to meet.

(b)(3) NatSecAct

Historical Background

Upon receipt of the problem, Dr. Chadwell requested the assistance of [redacted] Chief of the Engineering Panel, and his Deputy, [redacted] With the help of that office, approaches were made to the [redacted] in Los Angeles and the [redacted] Division of the [redacted] As a guide both the original British model and a device designed by Major Sam Lucy of OSS were at hand. The latter incorporated a sylphon bellows as the actuating feature and was entirely mechanical in operation.

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct
(b)(3) NatSecAct
(b)(3) NatSecAct

Within a month the [redacted] Subdivision had decided against further work, and a contract was initiated with the [redacted] Corporation. This firm, with the able assistance of [redacted], showed great originality, exploring the sylphon bellows idea, aneroid diaphragms, and helical Borden tubes before

(b)(3) NatSecAct
(b)(3) NatSecAct
(b)(3) CIAAct
(b)(6)

accepting as the most promising lead a system [redacted] (b)(3) NatSecAct

At a Division meeting in July 1943 the first working models were demonstrated, and the temperature compensation requirement was decided upon as essential to prevent premature operation of the fuse in a plane parked on the ground. During the following weeks the contractor explored several ideas to accomplish this temperature requirement [redacted] (b)(3) NatSecAct The latter proved the best of these attempts and was accepted as the basis of the first production design (Mark I), and although not entirely satisfactory was used because of the urgent demand.

Much more satisfactory was the solution of the drop shock requirement. This was accomplished by an ingenious counter-weight principle.

(b)(3) NatSecAct

In October and November, MRL tests confirmed the adequacy of the models, and OSS proceeded with a letter of intent for the production of 1000 units by the [redacted] with the proviso that [redacted] assume the responsibility for supervision of production. This he did in his capacity as Consultant to the Engineering and Transition Office and at the request of Division 19. The explosives group at MRL simultaneously designed and tested the detonating and explosive parts of the Anerometer. (b)(3) CIAAct (b)(6)

Production of the Mark I by January had reached the rate of 300 un[redacted] week and seemed moderately satisfactory. (b)(3) CIAAct (b)(6)

(b)(3) NatSecAct

At this time Dr. Bush suggested that [redacted] (b)(3) NatSecAct [redacted] might contribute an idea which would better satisfy the temperature compensation problem. [redacted] therefore visited the [redacted] and from their conversations came renewed consideration of the principle of the calibrated leak so extensively used in rate of climb meters. (b)(3) CIAAct (b)(6)

(b)(3) NatSecAct

Mark I models with the bi-metallic compensator omitted were fitted with capillary tubes of 0.005 inch diameter and dispatched to MRL in June 1944 for trial. These tests (MRL Report No. 112 of July 21, 1944) indicated that this principle was superior for temperature compensation, and with the additional feature of a paper filter to exclude dust from the fine capillary tubes, this design was accepted as the Mark II Anerometer and formally approved by OSS in August (cf. MRL Reports No. 135 of September 9, 1944, No. 166 of December 30, 1944, and No. 177 of February 5, 1945). Both SOE and OSS were convinced that the Mark II model was vastly superior to the Mark I, and the bulk of the very large production was of this model.

(b)(3) CIAAct
(b)(6)

Throughout the program MRL was of great assistance, ably represented by [redacted]

It was gratifying to all to learn in January 1945 that a large number of Anerometers had been extremely effective in Yugoslavia.

Technical Information

[redacted]

(b)(3) NatSecAct

Problem Submitted: May 22, 1943. Problem Terminated: December 26, 1944.

Contract: [redacted] (b)(3) CIAAct (b)(3) NatSecAct (b)(6)
official investigator; May 24, 1943, to August 31, 1944.

Final Report: Serial No. 21 submitted to [redacted] on December 27, 1944.

(b)(3) CIAAct
(b)(6)

Patent Report: Forwarded to Captain [redacted] on May 8, 1945.

(b)(3) CIAAct
(b)(6)

(b)(3) NatSecAct

[redacted]

Approved for Release: 2018/06/04 C03126390

(b)(3) NatSecAct

(b)(3) NatSecAct

[redacted]

SAC-28 BEANO

Operational Background

Mr. S. P. Lovell, in conversations with various high ranking officials in the War and Navy Departments, came to the conclusion that in legitimate field operations the need existed for an effective hand grenade operated by impact fuse and shaped like a baseball. The idea was not new but apparently had received no impetus, although the requirement for an impact grenade had existed for many years in Ordnance. A weapon of this general type would make use of the supposed familiarity which American soldiers have with the throwing of a baseball. If it were successfully developed, it would be of importance to OSS as well as the legitimate Services.

Mr. Lovell therefore submitted the problem to Division 19 with the support of SOE representatives, although not at their request.

General Statement of the Problem

The characteristics, suggested and implied, of this grenade were as follows: (1) It should be the same size as a baseball (a sphere 9-1/2 inches in circumference); (2) It should approximate its weight (5-1/2 ounces); (3) It should fire on impact rather than by time delay; (4) It should fire reliably when dropped from a height of 18 inches onto sponge rubber; (5) It should be spherically balanced; (6) It should have optimum lethal fragmentation; (7) It should have two arming mechanisms, the second to take place during flight; and (8) The arming pin should be reversible.

Historical Background

(b)(3) CIAAct
(b)(6)

The various NDRC and OSS travelers who had visited SOE establishments in England had met Colonel [redacted] the originator of the British Army All-ways Fuse No. 247, and had been favorably impressed with its performance. This device was in very large production and was a part of the standard grenade No. 69 Mark I, an entirely plastic unit in Canadian and British Army use. Upon receipt of the OSS problem it seemed natural to call upon the British experience. Information obtained from SOE, together with ideas suggested by a number of Italian fuses, became the basis of immediate work on the Beano fuse.

(b)(3) CIAAct
(b)(6)

Immediately upon receipt of the problem by the Division, the fuse aspect was assigned to MRL where it was primarily the responsibility of [redacted] Dr. G. B. Kistiakowsky, who was at that time a member of Division 19,

(b)(3) CIAAct
(b)(6)

accepted responsibility for the fragmentation and explosive part, and this was handled at the Explosives Research Laboratory of Division 8 at Bruceton with [redacted] in charge.

(b)(3) CIAAct
(b)(6)

Throughout September, MRL and ERL continued their separate ways in a preliminary exploration of the field, and as a result it became apparent that the original requirement regarding weight would have to be relaxed, for an object the size of a baseball and having a weight of only 5-1/2 ounces would have a negligible payload and would be a very ineffective grenade. It was important to know just what the maximum weight would be, which would still preserve the throwability of a baseball, and this MRL clarified by issuance of a report indicating very little loss of accuracy and distance when a baseball-shaped unit was increased in weight to 12 ounces. Accordingly, with the consent of OSS the specification was modified and the allowable Beano weight was increased to 11 ±1 ounces, while at the same time it was specified that the case and the charge should constitute 9 ounces of the total. The subject of throwability of weights was reviewed on further occasions, and the decision of September 1943 was always confirmed (see MRL Reports No. 47 of February 26, 1944, No. 129 of August 31, 1944, and No. 225 of July 12, 1945).

At the same time Mr. Lovell called on Colonel W. W. Holler, Chief of the Ordnance Section of the Ordnance Department and secured Ordnance's opinion that they preferred "to have NDRC develop a finished Beano" and promised to "give such a finished development the highest priority for testing."

(b)(3) NatSecAct
(b)(3) CIAAct
(b)(6)

By the first of October it was apparent that neither ERL nor MRL had the facilities required for production of adequate samples for test, and it was learned that the [redacted] had some free shop space. [redacted] representing ERL and Division 19, had conferences with [redacted] personnel resulting in the negotiation of a contract with them for the purpose of producing designs [redacted] design based on the original British work and combined with some Italian additions. The scene was therefore set for immediate commencement of [redacted] participation.

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct
(b)(3) NatSecAct
(b)(3) NatSecAct

In November a number of concrete suggestions, together with sample fuses, were brought from [redacted] by Dr. Lothrop from England, and their arrival was most timely for a meeting of all interested groups which took place at MRL. It appeared that the chief difference between [redacted] suggestion and MRL designs lay in [redacted] preference for a fuse chamber having cam surfaces at both bottom and top. The MRL fuse had a conical bottom and only one cam surface. Both designs, however, made use of the work which [redacted] had already done demonstrating that the angle of the cam surface should be as close [redacted] as possible and that the contour of the needle point in the striker was a critical matter. It appeared impossible to choose between the single and double cam designs without test

(b)(3) CIAAct
(b)(6)
(b)(3) CIAAct
(b)(6)
(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct

samples, and it was decided that the [redacted] should prepare fifty fuses of each.

In another respect these two fuses were practically identical, both making use of [redacted] method of accomplishing arming in flight. This was done by the use of a so-called butterfly cap connected to a secondary arming pin by means of a nylon string. On being thrown, the butterfly performed the final arming by being caught in the air stream and, after unwinding the string, pulled the safety.

While [redacted] was to prepare these two lots of fuses for a decisive test, ERL continued its work on the selection of an explosive filling and very soon discarded [redacted]. A choice was also made between two types of initiating systems. [redacted] The latter system, while more space consuming, was found to give high order detonation in every case. The decisions reached were confirmed in a meeting in [redacted] office on November 17, at which time Ordnance requested 300 models for test and constructively criticized certain of the design features.

The [redacted] model shop provided [redacted] with the fuses of types 1 and 2 for test on December 1. It appeared that they were very sensitive, 50 percent firing occurring in a drop of 6 inches onto sponge rubber. In view of these results and certain features which recommended the MRL model over the [redacted] model, the Division 19 meeting of December froze on the MRL-designed fuse and requested that [redacted] proceed to tool up for the production of 1000 units to satisfy the demands expected from the various Service testing boards.

Very soon thereafter, ERL recommended that the filling should be either [redacted] By this time also, Mr. Lovell had revealed the development to Major General S. G. Henry, head of the New Developments Division, and to Major General W. F. Deane, Chief of the Army Ground Forces, requirements. The result was the establishment of regular liaison with Army Ground Forces (Lt. Colonel A. L. Feldman and Lt. Colonel L. D. Fargo) and the passage of a letter from Major General L. D. Clay to the Chief of Ordnance dated January 15, 1944, putting Beano on high priority and requesting that Ordnance facilitate the forthcoming tests and develop accessories such as a rifle launcher.

Division 19 called a meeting on January 20 of all the Service groups, and decisions were made on the details of loading and on the shipment of units to Aberdeen Proving Ground and Fort Benning, Georgia. It appeared that 2000 units would be required. A full report of developments to date was circulated to the interested parties on January 25, when Beano was very nearly in its final form. This report quoted fragmentation and sensitivity data, from which it appeared that Composition A was the better filling and that the grenade was considerably superior to the Mark I grenade in lethal fragmentation.

On January 29, the Ordnance Department assigned names to both the grenade and the fuse, Beano thenceforth being known to them as "Grenade, Hand. Fragmentation, T13" using "Fuse, Grenade, Impact T5." While the [redacted] (b)(3) NatSecAct company was proceeding to fill the Division 19 request, it appeared that time could be saved by Ordnance if an order were placed at once for the tools necessary for mass production. On February 14, Major General Clay authorized Ordnance to proceed with such a letter of intent upon the recommendation of the Director of OSRD, and Major General Henry, Chief of the NDD. In making this recommendation, he remarked as follows about the Mark I grenade: "The American fragmentation hand grenade continues to be mentioned unfavorably. All reports point out defects or mention the grenade disparagingly." A factual comparison made by [redacted] (b)(3) CIAAct (b)(6) then connected with Division 19, of the T13, the Mark I, and various foreign grenades tended to support this statement. It was noted, however, that the standard Army grenade when loaded with 2.05 ounces of TNT compared very favorably with Beano, and this change in loading from a nitrocellulose EC powder charge of 0.74 ounce resulted later in the issuance by Ordnance of the Mark II A1 grenade.

By late February the [redacted] (b)(3) NatSecAct company had completed production of the original order and supplied ERL with cases for loading with Composition A, TNT, and inert material and had supplied MRL with fuses for assembly with the M26 primer, the M17 detonator, and the tetryl rings. The samples desired for shipment to Aberdeen arrived there in March, and an exhaustive series of tests began on March 28. These included fragmentation, sensitivity, jolt and jumble, chemical stability, compatability, temperature effect, and accelerated aging tests. Results very quickly confirmed MRL tests of a more cursory nature (MRL Report No. 65 of March 30, 1944). By the first of April, Aberdeen was satisfied that the units were safe for test by the Infantry Board at Fort Benning, Georgia.

On April 4, a second Beano conference was held with all the interested Service groups and NDRC's research and procurement program and the testing program of the Services were confirmed. The Infantry Board tests got underway at once with NDRC personnel in attendance and were very elaborate operational trials using live grenades and Infantry soldiers. They were given considerable impetus by the information passed on by General Henry that Secretary of War Stimson wished a quick decision. The Infantry tests were extremely satisfactory, but the same could not be said for the Aberdeen or Camp Hale, Colorado, tests. In the former, three men were injured, although not seriously, by an accidental dropping of a grenade, and some officers in Ordnance proceeded to doubt Beano's effectiveness. In the latter, it was found that the sensitivity on soft snow was very poor and that the neoprene washer which separated the fuse from the body tended to stick when cold resulting in duds due to failure of the butterfly to release.

In May, further samples were requested by Ordnance for Picatinny Arsenal study, and it was the conclusion of ERL fragmentation tests that Composition A was definitely the best filling for the grenade and that Beano should be considered as an offensive grenade with a lethal range of about 10 feet from the point of burst.

At the suggestion of General Henry, a meeting was called on May 6, 1944, attended by all the interested groups, at which time NDRC progress in eliminating the sticky gaskets and strengthening some parts which had shown weakness at Aberdeen was reported. At the same time, Army Ground Forces stated definitely that they wished a large number to be procured and Ordnance assumed the responsibility for this, with NDRC's offer of assistance.

On May 15, the Marine Equipment Board tested Beano at Quantico with favorable results, and at the same time models were supplied at the request of Quartermaster for the design of a carrying knapsack. [redacted] visited (b)(3) CIAAct (b)(6) the Edgewood Arsenal assembly plants and there assisted in the details of loading the bodies and assembling the grenade. At the same time he brought the existence of Beano to the notice of those in CWS who were charged with the development for the Military Police of a CN grenade with an impact fuse. Samples were later supplied to CWS but did not meet their safety requirement because of the metal parts contained in the fuse which might conceivably injure some innocent bystander.

By June 2, matters had progressed to a decision by Army Service Forces to order 825,000 grenades, representing 15 percent of the total grenade production. This order was to fill OSS, Army Ground Forces, and Marine Corps requirements. Samples reached England in June at the request of Combined Operations and were favorably reported on in October. The Division then foresaw additional Service requirements, and accordingly the [redacted] (b)(3) NatSecAct was requested to make in all 3000 grenades. At the same time an Ordnance order was placed with the [redacted] (b)(3) NatSecAct company, and initial full-scale production began on August 21, 1944, within a year after the problem was presented to the Division. At the same time other activity was begun. This included the development of WP Beano by [redacted] (b)(3) NatSecAct, and the time delay Beano by MRL.

It appeared that Beano met a requirement received from the Southwest Pacific and Major General Henry agreed that officers should be dispatched there and to the European theater with production lots for field trial and appraisal. It was also at this time that the Division first heard through indirect channels of the development by Ordnance of a new spherical grenade known as the T15, a definite competitor of Beano.

The first production under the Ordnance contract was inspected by MRL and found to be defective in a number of minor points, all of which were connected with acceptance tests and inspection. At the same time the sensitivity of Beano appeared to have suffered adversely. This was traced to the primers which were supplied by Picatinny Arsenal, but nothing was ever accomplished, so far as the Division knows, toward correcting the difficulty. So serious did the matter of testing and inspection become that on September 19 a meeting of Ordnance, [redacted] (b)(3) NatSecAct and Division 19 personnel was held and a set of procedures agreed upon.

MRL's activities in this period included the issuance of reports covering development of the original T5 fuse (see MRL Reports No. 99 of July 5, 1944, and No. 106 of July 8, 1944) and reports covering the work on the Beano

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(b)(6)

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(b)(3) NatSecAct
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(b)(3) NatSecAct

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time delay fuse (Report No. 140 of September 20, 1944). The latter was a pyrotechnic device providing a time delay of approximately 4.5 seconds, an Ordnance specification. This report brought from Ordnance, on October 16, the statement that they had developed a T19 fuse and desired that MRL work should cease and that details be turned over to Ordnance. This was done, although later Dr. Chadwell in January 1945 reopened the problem and MRL had plans to produce 200 samples. These plans never were carried out (see MRL Report No. 224 of July 12, 1945).

Production models reached Fort Benning and were tested there by the Infantry Board with most satisfactory results (Report No. 1621B of 3 November 1944). On that same day, however, a most unfortunate accident occurred at Aberdeen, where a civilian was killed while carrying out routine throwing tests with Beano. Brigadier General Borden, who had succeeded General Henry as Chief of NDD, advised at once that production should be stopped and a full investigation made. Ordnance concurred in this recommendation and in addition made suggestions that when production was resumed a fuse of a new design (E1) should incorporate a number of ideas of theirs which would give greater safety. The Army Ground Forces, however, took a different view of matters and on November 11 requested that Ordnance should proceed as before and that samples should reach the field at once. They were not successful in preventing Ordnance, however, from stopping all production on November 18, 1944.

On December 6, Dr. Bush and Dr. Chadwell called on General L. H. Campbell, Chief of Ordnance, and it was there agreed that the grenades then in existence, after inspection, should reach the field while an improved fuse was being developed. This recommendation was made also by the Subcommittee on Ammunition to the Ordnance Technical Committee on December 9. On (b)(3) NatSecAct December 14, a conference lasting two days took place at [redacted] at which details of the E1 fuse and disposition of the production lots already in existence were settled. From this meeting emerged a suggestion of the (b)(3) NatSecAct [redacted] company for a fuse of considerably different design (E2), and by the end of the following month this type had so far surpassed the E1 or the original T5 that it was decided to resume production with it. This took place on February 24, 1945, when production recommenced at the rate of 2500 per day.

During this period a shipment of 10,000 of the T5 fused Beanos had gone to the European theater for field trials in charge of Major C. C. Hanover from Fort Benning. His cable of March 22 reported that prematures had occurred and that there had been casualties. This was followed by a recommendation on March 29 from Major General Campbell to General Stilwell, then Commanding General of Army Ground Forces, that Beano should be suspended from production and not released for Service trial. General Stilwell's concurrence in essence meant that Beano would not see field operation in the current war. Ordnance was charged with the determination of the cause of prematures and the correction thereof.

Upon Major Hanover's return, a meeting was held at the Army War College attended by Army Ground Forces and NDRC personnel. Major Hanover reported that 2742 Beanos had been thrown, that there were 10 percent duds due largely to the soft terrain and five prematures which had killed two men and injured forty-four. These had all occurred with the First Allied Airborne Army, and in spite of them the troops had expressed a definite desire to take Beano with them when they crossed the Rhine. Unfortunately this was prevented by the speed with which Ordnance issued its suspension order.

Ordnance proceeded with a full-scale trial of the T5 and T5E2 fuses to determine whether the prematures which had occurred in the field could be duplicated. Two suggestions had been made regarding the cause of these prematures; one was to the effect that the grenade in spinning would fire because of an eccentric weight distribution, the other that the butterfly in removing the arming pin gave the fuse a sufficient jerk to bring its (b)(3) NatSecAct parts into contact. The first of these suggestions appealed to [redacted] personnel, who demonstrated that at an rpm of 1800 approximately 50 percent firing could be obtained. Although no individual was found who could throw Beano with a spin exceeding 1200 rpm, this potential cause of prematures assumed importance. The second suggestion also seemed likely as the result of Aberdeen throwing tests which showed that if the thrower, contrary to instructions, did not hold the butterfly down with his finger the Beano could be made to premature as it left his hand.

On June 15 the Subcommittee on Ammunition recommended to the Ordnance Technical Committee that production should be stopped and that all old production should be destroyed or stored until a new, safe fuse could be worked out under Ordnance contract. The problems then remaining were (b)(3) NatSecAct agreed by Ordnance and [redacted] to be four in number and resulted in a design (E3) which was suitably changed as follows: (1) the center of gravity of the fuse was made to coincide with the center of gravity of the grenade; (2) the butterfly was provided with a holding attachment which made it practically impossible to hold the grenade without holding down the butterfly; (3) the first arming pin was replaced by a cotter pin identical with that used in the Mark II grenades; and (4) the fuse head which had been made of bakelite was made of cast zinc, thereby avoiding the frequently met difficulty of fragility.

This final design of the Beano fuse was accomplished after Ordnance assumed the entire responsibility for producing a grenade which would be satisfactory to them.

One other point was investigated by MRL at the request of Army Ground Forces. Various Beano bodies, including some which had been developed for WP Beano, were filled with flash powders provided by Section 11.2 and were thrown at night to determine whether they would be successful in blinding the enemy. It was concluded that a Beano of this type was entirely feasible from a technical point of view and could very easily be produced (see MRL Report No. 217 of June 2, 1945).

Technical Information

(b)(3) NatSecAct

[redacted]

(b)(3) NatSecAct

(b)(3) NatSecAct

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(b)(3)
NatSecAct

[redacted]

(b)(3) NatSecAct

[redacted]

Problem Submitted: August 28, 1943. **Problem Terminated:** June 30, 1945.

(b)(3) NatSecAct

Contract: OEMsr-955 with [redacted], on the original fuse. [redacted] Division 8, on the case. OEMsr-1254 with [redacted] official investigator; October 9, 1943, to July 31, 1945.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Final Reports: MRL Reports No. 106 on the "Development of the Beano Fuse" of July 8, 1944, No. 99, "Development of the Initiator," of July 5, 1944, No. 140, "Development of the Time Fuse," of September 20, 1944, and No. 224 of July 12, 1945, and No. 217 of June 21, 1945, "Flash Powder Beano." [redacted] summary report by Dr. [redacted] of January 25, 1944. Division 19 Serial No. 32 dated July 31, 1945, submitted to Dr. [redacted] on October 9, 1945 (OEMsr-1254).

(b)(3) NatSecAct
(b)(3) CIAAct
(b)(6)
(b)(3) CIAAct
(b)(6)

Patent Reports: The MRL fuse was reported to Captain [redacted] on July 26, 1944, and was later patented by the Army, Serial No. 593,498. [redacted] T5E2 fuse was reported to Captain [redacted] on 30 April 1945 and was patented by them, Serial No. 578,842. [redacted] Terminal Invention Report, OEMsr-1254, forwarded to Captain [redacted] on October 15, 1945.

(b)(3) CIAAct
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(b)(3) NatSecAct
(b)(3) CIAAct
(b)(6)

[redacted]

(b)(3) NatSecAct

(b)(3) NatSecAct

SAC-28 WP Beano
OD-176

Operational Background

When Beano was first called to the attention of Army Ground Forces in January 1944, Brigadier General Deane pointed out that should it be accepted for general Service use they would desire a number of modifications, of which a white phosphorus (WP) Beano would be the most important. It had been found that interspersing high explosive grenades with about 10 percent of corresponding white phosphorus grenades had a demoralizing and excellent effect upon the enemy. Soon afterwards, when the Italian Campaign had reached a stalemate, white phosphorus was demonstrated by the American Armies to be extremely effective against the Germans; hence the desire for the development of a WP Beano.

General Statement of the Problem

It was decided that the WP Beano should have the same dimensions and weight as the standard Service Beano and should use the same fuse. For the maximum anti-personnel effect it was ultimately decided that particles of white phosphorus should be ejected which on the average approximated 1/4 to 1/2 inch in diameter. This latter point amounted to an appraisal of white phosphorus as an anti-personnel weapon, something which was still not possible to define. The above figure represented a fair compromise between the British and American views on the subject and was logically dictated by economical use of filling: the particles which are too fine result in smoke without anti-personnel effects and particles which are too large have little chance of causing casualties.

Historical Background

Dr. H. M. Chadwell, acting upon this suggestion of Army Ground Forces, requested [redacted] to assume responsibility for developing a WP modification of Beano. A large number of U. S. and British reports on WP as a smoke and anti-personnel weapon, together with details of the standard CWS smoke grenade (M15) and CWS work on plastic bodies for phosphorus containers, was all made available to the contractor. [redacted], was assigned to the problem and commenced work in March 1944, using as a start the standard 0.040 steel case with standard fuse and former cups. At the same time he was supplied by [redacted] Company with similar cases of 0.020 steel. It was found at once that the standard tetryl bursting charge of the T5 fuse produced only smoke and that

the opening of the steel case by the explosion was variable with poor distribution of particles resulting. Moreover, steel was shown to be very inefficient on a weight and volume basis, since the dimensions remained at the baseball size and the total weight allowed was 12 ounces. That these steel cases also would prove difficult to seal against WP was made apparent by MRL test (see MRL Report No. 78 of May 2, 1944).

(b)(3) CIAAct
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Accordingly, steps were at once undertaken to secure plastic Beano cases; and since ethyl cellulose had been found by CWS to be the most satisfactory plastic for a WP container, this was selected and [redacted] placed with the [redacted] for a number of blown cases and with the [redacted] for a number of cast cases. The former were to be closed by the use of a cemented former cup, and the latter were to be closed at the bottom by a plug where a filling port was provided. In the latter design two castings were to be cemented equatorially.

(b)(3) NatSecAct

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(b)(3) NatSecAct

While the contractor was waiting for these bodies to be manufactured, he was placed in contact with [redacted] where under Contract OEMsr-102 Division 10 was conducting an investigation of PWP (WP plasticized with a solution of GRS rubber in Xylene). In May 1944, a target platform was set up at the [redacted] in Norwood, Massachusetts, [redacted] and a dropping tripod was designed so that accurate and reproducible testing of bursting grenades could be undertaken.

(b)(3) NatSecAct

(b)(3) CIAAct
(b)(6)

At that time Army Ground Forces requirements were more definitely stated and were received informally from Ordnance. It was desired that the WP Beano case should show no leaks at 85-pound pressure, should be unaffected by temperatures between $-40°$ and $150°$ F., should withstand repeated 10-foot drops onto concrete and jolt and jumble tests, should be chemically compatible and entirely waterproof.

(b)(3) NatSecAct

Arrival of the [redacted] cases in June showed that they were superior to steel but would not meet the various points given above. The occasion of submission of a formal Ordnance problem (OD-176) on June 27, 1944, was used to assemble the CWS, Ordnance, and OSS liaison officers for a demonstration at MRL. This demonstration included steel and plastic cases filled with WP, PWP, and SWP (WP reinforced with 8 grams of steel wool tufts of 000 grade). The results of this were the further requirements that particles should not travel beyond 20 yards and should be held if possible within 10 yards of burst. It appeared to those in charge of the program that neither plastic nor steel would be the answer but rather a material which would combine the good properties of both.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

It seemed that aluminum might do this, and accordingly on July 1 the assistance of [redacted] of America was requested to determine whether white phosphorus would be compatible with aluminum. The desirability of using a metal became even greater when it was demonstrated that the plastic bodies represented a fire hazard, since they would ignite one another in case of phosphorus leakage. On July 20 a group visited the

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(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

[redacted] and there demonstrated WP Beano and secured the assistance of the company in getting material and in locating a suitable contractor.

A number of firms were contacted before a meeting was called of CWS, Army Ground Forces, Ordnance, and Division 19 personnel. This took place on August 22 and was attended by a representative of the [redacted] (b)(3) NatSecAct who had agreed to consider the making of aluminum WP cases resembling the Northern Industrial plastic case. This meeting included a demonstration at Norwood of all previous types of body and filling, with aluminum cases provided by [redacted] being shown as well. It was decided that the [redacted] should tool up to make 5000 cases, that the [redacted] (b)(3) NatSecAct would supply the necessary brazing alloys, that the design would approximate the [redacted] case, that Ordnance would supply the needed fuses, and that [redacted] would supply the booster cups for the T5 fuses.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

(b)(3) NatSecAct

Both PWP and SWP were put aside at this time, and from that time on WP filling was agreed as the best approximation to the Service requirement. The decision to put aside PWP was based on the fact that this munition was not yet standardized, that it did not have any clear anti-personnel advantage over WP, and that it was less efficient on a weight basis.

On August 28, the [redacted] reported that aluminum and phosphorus (b)(3) NatSecAct were entirely compatible (see their final report of February 16, 1945).

While the [redacted] was proceeding to make its tools, visits were paid (b)(3) NatSecAct during September and October to Edgewood Arsenal and the assistance of the Chemical Engineering Division was obtained in settling details of plug size, pipe threads, surveillance, filling, etc. By the end of November the first shipment to Edgewood Arsenal of grenades was made and the Bohn production line began to operate. This continued during December, when Ordnance assigned names to the unit as follows: "Grenade, Hand, Smoke, WP, T28" and "Fuse, Grenade, Hand, T21."

With a good supply of WP units on hand, a second gathering of interested parties took place on January 5, 1945, at Norwood. The aluminum bodies filled with WP, SWP, and PWP were demonstrated and the previous decisions were confirmed. In addition, it was arranged that Edgewood Arsenal would assume the responsibility for loading the units and after CWS surveillance they would be released to the different Service boards at Edgewood, Aberdeen, and Fort Benning for test.

January, February, and March were consumed in supplying Edgewood with different lots of bodies which were then filled and subjected to surveillance at 150° F. Four from the first lot of 84 were found to leak, and this resulted in a changing of the design of the bushing around the filling plug. Of the second lot of 100, only 1 leaked, and it appeared that the female threads in the plug were of poor quality. When these were corrected, a third lot of 100 was filled; no leakers resulted. By March 23, Major J. L. Traub of Edgewood had released 500 bodies for further Service testing, but this never came about because of Ordnance restrictions on the use of the

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fuse. At that time Edgewood Arsenal expressed the opinion that the unit in its final form was entirely satisfactory from a filling and storage point of view, which with WP munitions had always proved a difficult point. It was nevertheless clear that a very rigid inspection of plug threads would have to be set up if a high quality production was demanded.

Throughout the last eight months of the development, the T5 fuse was under criticism; although the fuse in the WP unit was identical except for the size of the burster, the work of the contractor was very little hampered, and no difficulty was experienced in securing the cooperation of Edgewood Arsenal in the filling studies.

Production was not started by the Services because the war ended before an impact fuse was accepted as satisfactory to the Ordnance Department.

<u>Technical Information</u>

(b)(3) NatSecAct

[redacted]

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Problem Submitted: June 27, 1944. Problem Terminated: August 13, 1945.

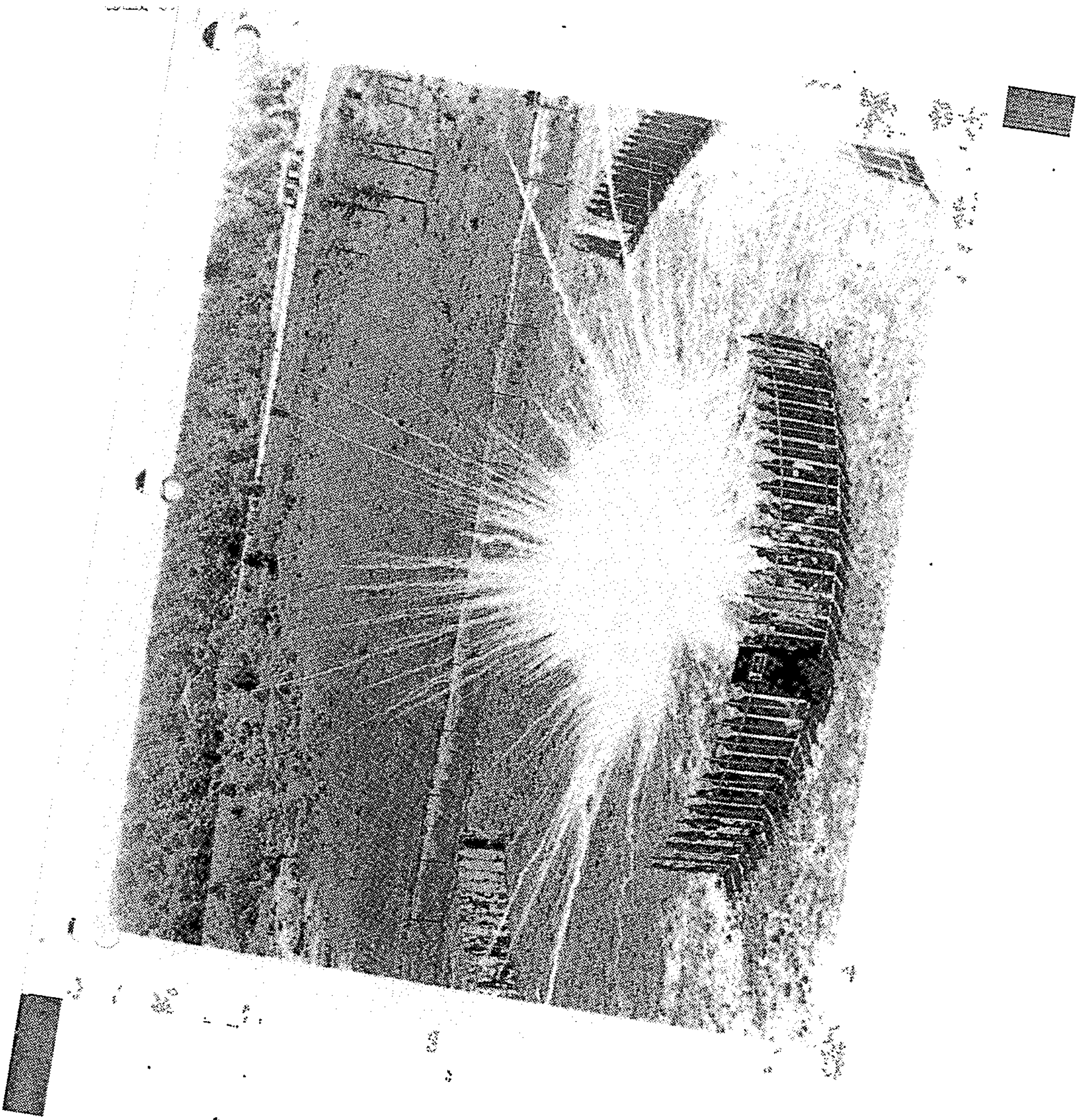
Contract: OEMsr-1023 with [redacted] official investigator; May 24, 1943, to June 30, 1945.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Final Report: Division 19 Serial No. 22, Part VIII, dated July 31, 1945, submitted to [redacted] on October 5, 1945.

(b)(3) CIAAct
(b)(6)

Patent Report: No inventions were made.



[redacted]

(b)(3)
NatSecAct

OFFICE OF SCIENTIFIC
RESEARCH & DEVELOPMENT

HISTORY OF DIVISION 19

VOL. III OF III

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(2) Bushmaster - Pull Type
(3) Bushmaster - Multiple Shot
M3 Machine Gun Equipped with Bushmaster
252C SPIGOT TARGETS 9=Inch Reinforced Concrete Automobile
261A VERITAS
265A Plastic Limpet Equipped with AC Delay, Pin-up, and Sympathetic Fuse
265B Limpet Explosion on the S. S. Gaspar di Partola Damage done by each Explosion
267A Balsam - Sample Sheet after Exposure to Tropical Conditions
276A Incendiary Moth - Small and Medium Size Notebooks
276D Explosive Moth - Briefcase Size; Explosive Moth inserted in Briefcase
288A Dog Drag with Ampule Removed
293A Small Filter-Type Water Purifier
298A Johnson 22-H.P. Silenced - Painted parts are Accessories
298B Johnson 22 Accessory Kit

Classification: Restricted

SAC-29 ST. MICHAEL

Operational Background

This problem was of primary interest to the British who, at the time it was submitted, had built up over occupied Europe an elaborate system of intelligence and espionage. Agents were frequently dropped by parachute with the object of gaining information, and this was transmitted by them at a prearranged time and place to British aircraft circling overhead. The agents' reports were transmitted by the S phone, a British invention, and received in the plane.

Unfortunately, many of the agents used spoke very obscure dialects which were frequently unintelligible to observers in the plane. The problem existed, therefore, of finding a simple way to record the agents' words for decipherment later at the British home bases.

General Statement of the Problem

It was known that in Division 13 work had been done on a magnetic wire recorder having a total playing time of about 30 minutes, exceedingly low input energy, and good mechanical and acoustical properties. It was asked that this development be adapted to the required use.

Historical Background

(b)(3) CIAAct
(b)(6)
(b)(3) CIAAct
(b)(6)

The problem, at the request of Dr. Chadwell, was handled entirely between Division 13, represented by Dr. J. F. McClean and Dr. A. F. Murray, and OSS, represented by [redacted] In March 1944, it appeared that the OSS requirement was substantially complete, and it was understood that [redacted] had arranged directly for the purchase of a number of sets from the [redacted] which had been the Division 13 contractor. The problem was therefore considered satisfactorily terminated.

(b)(3) NatSecAct

Technical Information

Since the device was entirely in the hands of Division 13, it is not possible to quote technical details here. However, it was known that the Division 13 recorder did not differ in principle from the recorders described in the public press, which originated with the General Electric Company and the Armour Research Foundation.

Problem Submitted: September 7, 1943. **Problem Terminated:** July 17, 1944.

Contract: Division 13 contract with the [redacted] (b)(3) NatSecAct

No final or patent reports came to Division 19.

Classification: ~~Secret to Confidential~~

SAC-30 CAMEL

Operational Background

Both the British and OSS had need of ways of smuggling into occupied territories a great variety of sabotage equipment. During the long years when England was a solitary fortress off the coast of Europe there was a great traffic in subversive devices, explosives, and incendiaries. Some of this material was carried in by agents who landed secretly from aircraft or boats in isolated spots. Much more of it was introduced largely by the British through theuse of fishermen whose boats made rendezvous out of sight of land and received quantities of camouflaged objects. Very popular were large fish which when mixed with part of the cargo became indistinguishable from the real articles, but which proved to be filled with submachine guns and rifles. Bundles of faggots turned out, on close examination, to be containers for standard explosive charges, incendiaries, and the whole gamut of sabotage devices. Other examples could be cited.

(b)(3) CIAAct
(b)(6)

All of this activity in England was conducted at Station XV under the direction of [redacted] who had assembled a large staff of camouflage experts trained in the cinema industry. A museum of their products occupied several large rooms. This was in part the result of their originality and in part was a tribute to the thoroughness of the Gestapo, for it was undesirable to use the same device so frequently as to lead to recognition.

Because OSS entered this field at such a late date, it was not deemed advisable to attempt a duplication of the large and effective establishment of Station XV. However, it was desired that there be in this country a small group which would carry on "the faithful reproduction of selected small articles indigenous to enemy and occupied countries," the modification of such articles by "the introduction of secret compartments for the transmission of intelligence," and "the conversion of small weapons of destruction without loss of function to passable facsimiles of articles in common use."

General Statement of the Problem

While the problem was given originally in the very broad terms quoted above, in actual practice OSS requested that Division 19 develop specific items. This arose partly from the reluctance of the Division to undertake to duplicate the elaborate British set-up with its full facilities for large-scale reproduction, and partly from the OSS establishment within its own structure of a group skilled in forgery and imitation.

Although a number of ideas came forward under the Division program, only four reached the stage of actual acceptance, production, and presumably use.

These were flashlight cells suitable for the concealment of documents, explosive coal, known as Black Joe, explosive cordwood, and explosive candles.

Historical Background

In October 1943, at the time when the general problem was submitted, the first specific request for a camouflaged [redacted] was received and forwarded to MRL, who assumed responsibility for the Division in this problem. To handle it MRL secured the services of [redacted] an artist and camoufleur of considerable ingenuity. By the first of March 1944, the group at MRL had successfully demonstrated that a standard flashlight battery could be easily modified to accomplish the purpose. Estimates of cost were given, and OSS procured a number.

(b)(3) NatSecAct
(b)(3) CIAAct
(b)(6)

At about the same time, MRL undertook the development of camouflaged coal. The idea of using a high explosive camouflaged as coal was certainly not new. The British had used it for years on the Continent, and the Germans were known to have samples of a similar material. In all this preliminary work, the custom had been to take a large lump of natural coal, carefully excavate the interior, fill this with high explosive, and equip it with a heat sensitive detonating system. Lumps of this kind were readily thrown from bridges into the tenders of locomotives, or could be surreptitiously introduced into storage piles. However, by the time of MRL activities Europeans had become very wary of large lumps of coal, and the custom had been introduced of smashing such lumps with a shovel. For this reason, and because such excavated lumps did not contain very large explosive charges and therefore were not very effective, the use of them had been abandoned.

MRL approached the problem with the idea of making a lump which, while not containing any natural coal, appeared, nevertheless, entirely that. This they accomplished by pouring melted Pentolite, containing up to 5 percent lampblack, into plaster of Paris molds made from actual coal samples. A first report of this in January 1944 was well received, so that MRL was encouraged to try the functioning of this device on an actual locomotive. This was done in February at Aberdeen with excellent results. Samples were provided in the spring for field appraisal, and in June word was received from England that a quantity should be produced. Up to October MRL worked very closely with the [redacted] with the result that approximately [redacted] lumps of excellent appearance, mechanical strength, and moisture resistance were produced by OSS.

(b)(3) NatSecAct

Simultaneously work was completed on the very similar problem of producing explosive firewood, except that here it was found necessary to chisel out a cavity for the plastic explosive.

In February 1944, Colonel Carl Eiffler, who had organized a number of operations in Burma, returned to Washington, and on his behalf Mr. Lovell submitted a request for an explosive candle. Colonel Eiffler said that in his theater of operations the Japanese depended upon white tallow candles for

illumination, and that it was customary for one of these to be placed in the center of a table around which a group of officers would be gathered. It was apparent that if this candle contained an explosive charge and shrapnel, it would be in an excellent position to damage the enemy.

MRL in June submitted a report of an effective device, and this also was produced by OSS with a continuing advisory service of the MRL group to the manufacturer, [redacted] (b)(3) NatSecAct

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(b)(3) CIAAct
(b)(3) CIAAct
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One other service was provided by Division 19 to OSS under this problem. That was the assignment of [redacted] through the Office of Field Service, to the [redacted] OSS group. It was believed that his special talents and background could be immediately useful in the field in the preparation of quantities of coal and in the solution of the numerous small camouflaging problems which were continuously arising. [redacted] services were available from the period June 1944 to July 1945. The reports of his work are to be found in the files of the Office of Field Service.

With his departure from this country, the active work of MRL and the Division on SAC-30 was terminated.

Technical Information

1. [redacted] (b)(3) NatSecAct

2. Black Joe (Explosive Coal)

This consists of high explosive [redacted] cast into molds form (b)(3) NatSecAct originally from actual lumps of coal. The coal is colored throughout (0.5% lampblack) and is reinforced against breakage by black enameled scrim. This cast material is resistant to fracture, but should it be chipped, the fresh surfaces exposed appear entirely non-suspicious since it is homogeneous throughout.

The chief difficulty encountered in manufacturing the device lay in the waterproof initiating system. This was important since if it did not work quickly the whole lump would be consumed harmlessly by the fire. The igniter of lead styphnate is sealed in the end of an Engineer Corps blasting cap with plastic waterproofing material, and when coated with plastic cement containing lampblack, is well concealed while at the same time being readily ignited.

The one major test performed on a locomotive showed that the effectiveness depended somewhat on the location of the lump in the fire box.

"When the charge was placed approximately 1 inch away from the walls, it blew a 3x4 inch piece through the inner wall, and the subsequent pressure wave in the water made approximately 1-foot tears in both the inner and outer fire box walls. The boiler was not under pressure, but it is presumed that it would have been exploded if it had been."

3. Explosive Firewood.

Details were provided on how to split and excavate a round log, fill it with plastic high explosive, fuse it, and reassemble the log. A test of one of these containing 1/2 pound of Composition C2 was conducted in an outdoor campfire. After 19 min. the loaded fireplace wood exploded with violence.

Although a satisfactory device was developed, it was never produced, because the target for which it was destined, namely the wood-burning Thailand-Burma Railroad, was too inaccessible.

4. Explosive Candle.

White wax candles moulded in the conventional shape of approximately 1 in. in diameter can contain a moderate charge of explosive (45 g.) and shrapnel without arousing suspicion due to the weight increase or the loss of translucency. [redacted]

(b)(3) NatSecAct

Problem Submitted: October 23, 1942. Problem Terminated: October 5, 1944.

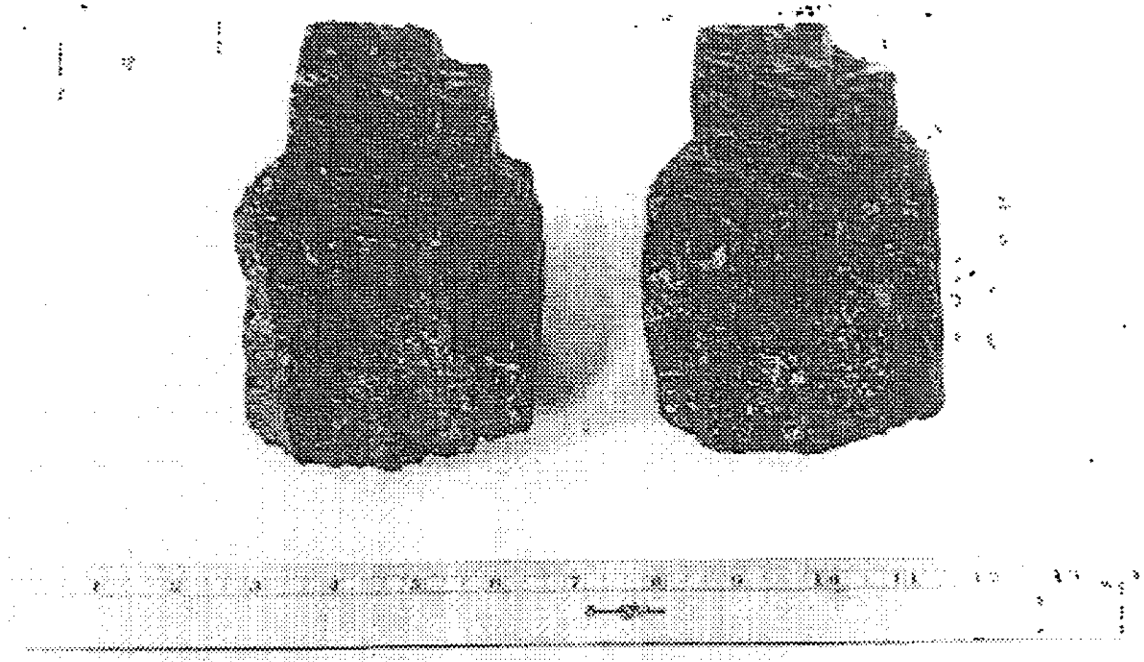
Contract: OEMsr-955 with [redacted]

(b)(3) NatSecAct

Final Reports: MRL Report No. 94 of June 24, 1944, on Explosive Coal.
MRL Report No. 82 of May 10, 1944, on Explosive Firewood.
MRL Report No. 88 of June 1, 1944, on Explosive Candles.

Patent Report: Patent reports on Black Joe, Explosive Firewood, and Explosive Candles were submitted to Captain [redacted] on April 11, 1945.

(b)(3) CIAAct
(b)(6)



(b)(3) NatSecAct

[redacted]

Classification: ~~Secret to Confidential~~

SAC-31 TEAK

Operational Background

At the time when this problem was submitted, OSS attention, and SOE to a lesser degree, was being directed toward Burma and Southeast Asia. Transport throughout this region was very vulnerable. Since roads were few, the even more limited railroads and sea-going communications were of the greatest importance to the Japanese. Naturally both targets were extensively exploited by the Air Forces and by the Navy. However, it was felt that sabotage had a place in the eneral attack in two ways. The railroads passed through country which necessitated many small bridges, most of which were presumed to be built of native hardwood. The ocean-borne commerce had at the start been carried in steel freighters but the supply of these was seriously depleted by the successful submarine campaign, with the result that the Japanese turned more and more to theuse of small wooden ships powered by diesel engines. These vessels varying in size between 100 and 500 tons were able to carry in the aggregate a considerable tonnage of supplies to the numerous Japanese garrisons and outposts throughout the South Pacific islands and along the coast of the mainland.

General Statement of the Problem

Briefly, the problem appeared to find convenient sabotage methods which would result in the destruction of wooden bridges and wooden ships.

Historical Background

1. Bridges.

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(b)(3) NatSecAct

The problem was presented to NRL, and at the same time Dr. Chadwell secured the services of [redacted] to act as special adviser. Through his good offices [redacted] an expert of the Forest Service in the Department of Agriculture, was released to OSRD for six months temporary duty. From this time on [redacted] worked very closely with those at NRL and assumed responsibility for the bridge problem in its entirety. The whole problem suffered from lack of data, and [redacted] attempts to locate information regarding the type of bridge construction and the type of wood used did not bear much fruit.

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By the end of January 1944 the operational picture changed somewhat and doubts were expressed in OSS regarding the policy of destroying the Burma-Thai Railroad which the Japanese were completing and which would

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be of value to the Allies should they take over the theater. Nevertheless, [redacted] analysis of the problem continued. It included attack by insects, fire, decay, and explosives. Only the last of these appeared to have any promise, and since the Corps of Engineers had information indicating the size of explosive charge and its preferred location for bridge attack, the Division undertook no work along these lines. The next most promising method appeared to be fire, but as will be clear from the discussion under SAC-45 the tropical jungles are not likely places to bring about conflagrations.

(b)(3) NatSecAct

A folding chain saw made by the [redacted] for a while appeared promising for two-man attack on bridge members. It was thought that if the properly selected bridge members were nearly severed, the weight of a train would accomplish the rest. Unfortunately, a field trial at MRL in May showed conclusively that the chain saw method was impractical and extremely laborious. The death knell of the bridge problem was given by OSS Research and Analysis Report No. 1986 of May 6, 1944. It then appeared that recent intelligence indicated the Japanese to be using steel in their bridges!

2. Ships.

OSS Research and Analysis Report No. 1591 of December 16, 1943, contained all available details regarding the construction, dimensions, mooring, and routes of the wooden ships to be attacked. It appeared that the general construction was not sufficiently different from American practice to prevent trials at MRL on mock-ups. In late January 1944, it was decided therefore that a number of panels should be built on half scale and, by use of the dam and underwater pool at MRL, attacked with scaled down Limpet charges to determine whether the standard Limpet could be expected to be effective on wooden ships. MRL Report No. 63 of March 21, 1944, reported the complete destruction of these panels and subsequent experiments showed that even when the panels were backed by simulated cargo a Limpet could be counted upon to do considerable destructive damage and produce a hole of roughly 16 square feet in fairly strong wooden construction.

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(b)(3) NatSecAct

At the same time MRL initiated a separate line of attack. [redacted] felt that air-vapor explosions might be a feasible line of attack. This had already been considered in part by SOE, who had reported on the practicability of acetylene-air mixtures. After conversations with [redacted] in Division 11, [redacted] in the British Central Scientific Office, [redacted] in Division 8, and [redacted] in Division 2, [redacted] visited the Bureau of Mines at Bruceton, Pennsylvania, and witnessed demonstrations of coal dust explosions. This was followed by a similar visit to the [redacted] where a test house existed and where [redacted] had already begun work on a [redacted] whose principle was that of a dust explosion.

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On March 20, 1944, the first trial at MRL was made using 5 pounds of flour and various quantities of TNT, whose function was to act as a disperser and igniter of the carbonaceous dust. [redacted] saw at once that the test structure [redacted] would be needed for his work, and accordingly a subcontract was arranged under the existing [redacted] contract, OEMsr-1023, so that the [redacted] could assist [redacted] in providing facilities and could continue their own work on the [redacted], which later was christened "Salex."

(b)(3) NatSecAct (b)(3) NatSecAct (b)(3) NatSecAct (b)(3) CIAAct (b)(6)

By May 15, [redacted] work had reached the point when a full-scale trial against wooden ships seemed desirable. Fortunately the War Shipping Administration had in its possession in Baltimore Harbor a derelict wooden freighter named the S. S. Pawtucket. This 500-ton ship was made available, and a demonstration and trial of the dust explosion principle took place. Two different compartments in the ship were tried: one of [redacted]

(b)(3) CIAAct (b)(6) (b)(3) NatSecAct

The Limpet work had also reached the stage of a full-scale trial against wooden ships. This took place in late May at Hopewell, Virginia, when a 200-foot barge, the Hudson, was attacked by a standard Limpet (see MRL Report No. 93 of June 6, 1944). Serious damage was done and the previous work was entirely confirmed. It is obvious that magnetic attachment would not suffice on targets of this type, and the Pin-Up (SAC-3) was used. Throughout all of this work, at the request of Navy representatives of the David Taylor Model Basin were in attendance.

3. Houses.

Following the successful experiment in Baltimore, the use of the dust technique against structures such as warehouses suggested itself. The

TVA tests (SAC-49) provided a locus for such experiments. On August 30, 1944, a two-story lumber storage house having a volume of 30,000 cubic feet and little ventage was entirely demolished by the action [redacted] sack of flour. A nearby structure of one-story having a volume of 16,000 cubic feet but large ventage was seriously damaged (see MRL Report No. 152 of October 16, 1944). (b)(3) NatSecAct

Specifications for the disperser-igniter unit, thenceforth known as the "Lulu," were submitted to OSS on September 11. The device as designed could be operated either by an AC or a clockwork delay, was convenient for introduction into flour which might be picked up in the field, and seemed to be a complete answer to the original OSS problem. It was put into production and tests of the product were most satisfactory (see MRL Report No. 180 of January 20, 1945).

4. Slow Burning Explosive (SBX).

With completion of the original OSS assignment, the work of [redacted] did not come to an immediate end. Throughout October he and [redacted] performed further experiments [redacted] It appeared that the Lulu was very effective in dispersing and igniting other materials than carbonaceous dusts. Aluminum powder, gasoline, and a mixture of gasoline and aluminum were successfully used, and in that order of increasing effectiveness. (b)(3) CIAAct (b)(6) (b)(3) NatSecAct

At the same time, [redacted] was greatly improved, the best ratio of [redacted] to [redacted] and the best pressure for [redacted] being determined. In addition, a new test chamber became available [redacted] and a number of different pressure gauges were used in the work. It appeared that a decision was needed regarding the future of [redacted] (b)(3) NatSecAct (b)(3) NatSecAct (b)(3) NatSecAct (b)(3) NatSecAct

A large meeting was called, therefore, on November 14, 1944. In attendance were representatives of [redacted] Division 8, Division 2, Division 19, OSS, MRL, and SOE. It was decided that the OSS request had been completed but that Division 19 would carry on the [redacted] and Lulu experiments until Division 2 could determine whether they wished to pursue the matter more actively. Two days later [redacted] the British expert on the subject, was at [redacted] and gave his advice. Subsequently, Division 2 decided against continuing the work, and the final reports were prepared. (b)(3) NatSecAct (b)(3) NatSecAct (b)(3) CIAAct (b)(6) (b)(3) NatSecAct

In June 1945 [redacted] came to the attention of Division 11 and a trial was made of it by their contractor [redacted] Contract OEMsr-321) as a flash powder. The results were reported to be good. (b)(3) NatSecAct (b)(3) NatSecAct

5. Fast Burning Incendiary (FBI).

[redacted] of SOE, in December 1944, visited MRL and there brought to the attention of OSS, NDRC, and CWS a method which he had perfected for the rapid firing of wooden houses. This consisted in (b)(3) CIAAct (b)(6)

detonating a mixture of magnesium dust and powder. A trial at MRL on a specially constructed house measuring 12x12x9 feet was entirely successfully carried out, the structure being completely ablaze in all parts 1/2 minute after activation of FBX (see MRL Report No. 178 of January 31, 1945).

Technical Information

1. Lulu.

The igniter disperser developed for the initiation of explosions of flour is equally efficient for igniting explosions of dust and liquid SBX materials. [redacted]

(b)(3) NatSecAct

The so-called Baby Lulu extensively used in the testing in the [redacted] structure is a similar device containing 135 g. of Lulu mixture.

(b)(3) NatSecAct

2. SBX.

The most important factors involved in the SBX explosions are as follows:

a. Efficiencies of dispersion and ignition. The Lulu appears to be satisfactory for this purpose, and the confinement made by the strong casing, as well as the magnesium, is shown to be important.

b. [redacted]

(b)(3) NatSecAct

c. Concentration and limits of explosibility. In general it appears that within several feet of the point of burst the mixture of SBX material and air is in the explosive range.

d. Weight of SBX charge. This is not extremely critical but varies according to theory. The Lulu unit which weighs about 2 lbs. appears satisfactory for 100 lbs. of flour or 1 gal. of the liquid SBX materials. It is interesting to note that cast high explosives such as torpex are very effective also as substitutes for Lulu.

e. Rate of Combustion. This is affected by the variable factors mentioned above. It is obviously of great importance in determining the amount of damage. All the SBX materials are slow burning, which means that the period over which they are exerting an appreciable pressure on the walls of the confining space is of the order of 10 to 150 milliseconds. This contrasts with results from high explosives which provide a duration of a few milliseconds at most.

f. Venting. This is the crux of the usefulness of SBX as an explosive. The more complete the closure, the more damaging the result. In open air SBX is a very poor explosive.

3. Instruments to Evaluate the Effectiveness of SBX.

These gave considerable trouble. They were all different in design and principle and gave different results, but fortunately these are on the whole in good correlation with each other. The types used are as follows: (a) piezo tourmaline gauge, Division 2; (b) condenser type diaphragm gauge, General Motors Company; (c) piston spring gauge, Factory Mutual Corporation; (d) impulse gauge, Dr. C. S. Lu; and (e) cannon gauge, Factory Mutual Research Corporation.

4. [redacted] (b)(3) NatSecAct

As an igniter for flour, gasoline, or other SBX materials, it has been shown to be of little value. The CW aspects of Salex are obvious and might interfere with its use unless chemical warfare were being practiced.

Problem Submitted: November 22, 1943. Problem Terminated: June 8, 1945.

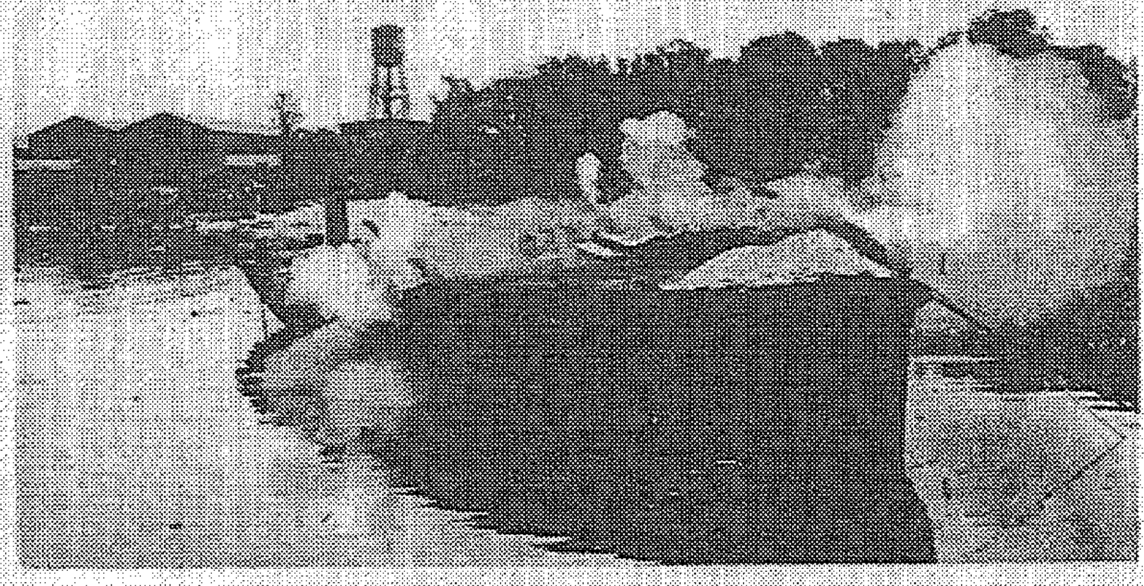
Contracts: OEMsr-955 with [redacted] (b)(3) CIAAct official investigator. OEMsr-1023 with [redacted] (b)(3) NatSecAct (b)(3) CIAAct (b)(6) [redacted] official investigator; May 24, 1943, to June 30, 1945. (b)(6) OEMsr-1023 subcontract with [redacted] (b)(3) CIAAct (b)(3) CIAAct (b)(6) [redacted] official investigator; March 1, 1944, to January 31, 194 (b)(3) NatSecAct

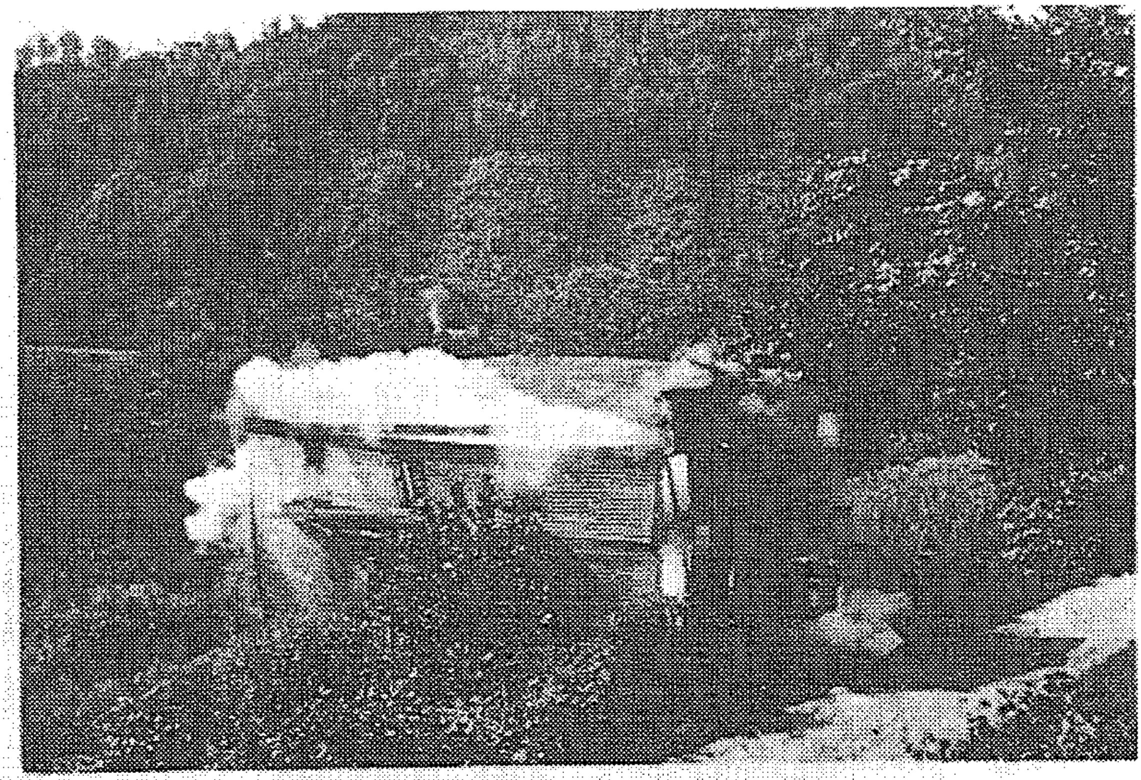
Final Reports: NRL Report No. 183 of February 28, 1945. Division 19 (b)(6) No. 22, Part IX [redacted] submitted to [redacted] (b)(3) CIAAct (b)(6) (b)(3) NatSecAct on October 5, 1945.

Patent Reports: At present writing, no inventions have been reported.

(b)(3) NatSecAct

RUN NO. 3 (Cont'd)





D.

SECRET

Classification: ~~Confidential~~

SAC-32 WOODCHUCK

Operational Background

It was obvious from field experience that the chances of really satisfactory train wrecks are greatly improved if they occur in tunnels or on bridges. Since both of these locations are generally guarded by the enemy the more conventional type of attack on the roadbed becomes impossible there.

The tunnel problem was met by the development of the Mole, already described, and the bridge problem was submitted separately.

General Statement of the Problem.

It was proposed by Mr. Lovell that perhaps the photo-electric cell of the Mole or some similar cell would operate by virtue of the greatly increased light which might fall upon it if it were placed under a railroad car which passed suddenly from land to an open trestle where reflection from the water would be considerable.

Historical Background

(b)(3) CIAAct
(b)(6)

[redacted] had a survey conducted from which it appeared that photo-electric cells were not sufficiently discriminating and that many European bridges had solid earth or cinder tops which would fool the best possible Woodchuck. He proposed that SAC-2a would provide a solution. This, however, required that an observer should initiate the charge, and demanded that he know the time when the particular car containing the radio fuse would appear. From an operational point of view this was impossible. Accordingly, the problem was abandoned.

Problem Submitted: November 25, 1943.

Problem Terminated: January 31, 1944.

Classification: ~~Secret to Restricted~~

SAC-33 BUSHMASTER
NR-109

Operational Background

In both OSS and Navy operations close contact with the Japanese in jungle territory was expected. In this type of fighting the exact location of friend or foe was most difficult to ascertain. The suggestion was made that the location of the enemy might be achieved by a ruse. It was planned to plant surreptitiously in the jungle a device which after a period of time would fire one or more revolver shots and simultaneously disturb the foliage. This, it was presumed, would attract enemy fire, and since the planters of the trap would be located on the other side in a good vantage point, they in turn would learn the location of the enemy.

General Statement of the Problem

A device to fulfill this requirement was requested, and the following characteristics noted: "It shall be small, portable, and self-activated. It shall be capable of being installed by a single operator in a bushy terrain and shall functionally, after a predetermined time delay, vibrate or move the bushes and intermittantly fire live bullets in a predetermined direction. It shall incorporate within itself either self-destruction or a booby trap mechanism." The last requirement was discarded almost immediately.

Historical Background

The problems received from OSS and the Navy differed only in the caliber of the cartridge to be used, and by mutual agreement work proceeded based on a .45, although later it would have been possible to develop models using either a .22 or a .30 cartridge.

(b)(3) CIAAct
(b)(6)

The Navy provided drawings of an idea submitted by [redacted], but this was discarded by the MRL group as being far too elaborate and complicated for the purpose. Instead, [redacted] advanced the suggestion of a modified time pencil suitably attached to a real gun or a cheap simulation and provided with a clip for attachment to tree limbs. This idea was very simple to test, and the problem was apparently solved, since the firing of the bullet gave enough recoil to the Bushmaster to shake the limbs to which it was attached.

(b)(3) CIAAct
(b)(6)

The idea appealed to the Services, and in February 1944 [redacted] of MRL submitted samples and a report describing the first model (MRL Report No. 46, dated February 17, 1944). Trial and criticism of this early model

(b)(3) CIAAct
(b)(6)

lead to refinements (MRL Report No. 66 dated April 3, 1944) and on the basis of this OSS instituted procurement. In the interests of simplicity and cheapness, further design changes were required, and these were detailed in the final report on the subject issued in July 1944 (MRL Report No. 113). The unit which was then accepted for production was a single shot, expendable item.

The solution of the multiple shot unit was more difficult, but it was finally achieved by clipping to the trigger of an M-3 submachine gun an adapted time Pencil which by its firing triggered the gun and discharged the entire clip. This also was accepted by OSS and procured in August 1944.

From time to time models were submitted through COMINCH to the Marine Corps Equipment Board at Quantico for tests, from which it appeared that the Navy had no requirement for this device, and if one arose, would use OSS as a source of supply.

Lastly, a very simple booby trap modification of the Bushmaster was devised at the request of OSS and put into production by them in the fall of 1944.

Technical Information

1. Single Shot Bushmaster.

[redacted] (b)(3) NatSecAct

2. Multiple Shot Bushmaster.

[redacted] (b)(3) NatSecAct

Problem Submitted: November 29, 1943, by OSS; December 10, 1943, by the Navy.
Problem Terminated: September 19, 1944, by OSS; February 20, 1945, by Navy.

Contract: OEMsr-955 with [redacted] (b)(3) NatSecAct

Final Report: MRL Report No. 113 dated July 21, 1944.

Patent Report: Forwarded to Captain [redacted] April 1945. (b)(3) CIAAct (b)(6)

(b)(3) NatSecAct

(b)(3) NatSecAct

SAC-34 FACSIMILE

Operational Background

Secret intelligence operators of both OSS and SOE had need, on occasion, to transmit photographs and drawings which could not be reduced to words. To do this expeditiously it was thought that existing radio equipment might be used.

General Statement of the Problem

NDRC was asked to develop "facsimile equipment for transmitting black and white pictures using the radio link comprising a small power transmitter of 15 watts rating." Operation from a 6-volt storage battery and from 110 or 220-volt A.C. (25-60 cycles) was desired. The size of the pictures was to be 4x5 inches, and the total weight 20 pounds for the complete equipment.

Historical Background

The problem originated with the British and reached Division 19 from [redacted], [redacted] of OSS. Since it concerned radio equipment, Division 13 was asked to consider the problem. Dr. A. F. Murray, Technical Aide of that Division, pointed out that in 1942 they had had a contract [redacted] along similar lines. The final report of this entitled "Aircraft Facsimile Equipment" was made available to the British, and entries to Fort Monmouth obtained for [redacted].

OSS and SOE felt that the requirements were not met by any previous work, and this opinion was confirmed by a canvas which Dr. Murray made of a number of manufacturers. Although one of these [redacted]) la down a complete proposal for a research program, this was never undertaken, and the problem was terminated by the SACOM Committee (see SAC-2) soon after its establishment in 1944.

Problem Submitted: December 10, 1943. **Problem Terminated:** November 9, 1944.

Classification: ~~Confidential~~ to Restricted

SAC-35 VARGA

Operational Background

In commando raids attack on key power stations was much favored. In such operations the transformers generally suffered, for they were accessible and vulnerable. Another favorite target was stand tanks of oil and gas, and in both operations it was desired to set fire to the liberated oil and fuel.

General Statement of the Problem

It was proposed that MRL should study the simplest way of "disrupting transformers and oil storage tanks and setting fire to the contents thereof."

Historical Background

It appeared at once that a considerable amount of British work had already been done which indicated that various types of shaped charges were most effective in opening up tanks and transformers, while auxiliary incendiaries of a delayed action type were depended upon to ignite the liberated contents. Drawings of the Josephine, Wreath, Star, and Cavity Link charges were obtained, and on appraisal appeared to give a satisfactory solution to the problem. Existing incendiaries such as Paul Revere (SAC-6) were also adequate. No active work was therefore undertaken by MRL.

[redacted], Technical Aide in [redacted] office, made various suggestions of transformer points vulnerable to sniper rifle attack, and suitable sketches were received by OSS and presumably distributed to their operators. (b)(3) CIAAct (b)(6)

Problem Submitted: December 15, 1943.

Problem Terminated: September 19, 1944.

SAC-36 MORTAR

Operational Background

Throughout sabotage and commando operations the need for flashless silent weapons has been apparent (cf. problems SAC-1, -13, and -14). In addition to hand weapons, it seemed that a device of longer range would be valuable. Targets visualized included selected houses, well guarded transformer stations, inaccessible gas and oil storage tanks, and the like. Presumably an agent could approach within 200 yards of a selected target, install his weapon, and conduct a successful attack which would be very difficult to combat if the source of missiles was undisclosed by flash or sound. In addition, the weapon should be provided with time delay action if desired and should be expendable.

General Statement of the Problem

A device meeting the above requirements had been developed by SOE in England, and was known as the Spigot Mortar. Demonstrations of this to both OSS and Division 19 visitors had convinced them that a useful device had been developed and that the United States should take steps to secure quantities for real OSS operation. At the same time it was felt that the Spigot Mortar would interest the Ordnance Department and Army Ground Forces.

In December 1944, OSS approached the British with a request for a share of British production. It embarrassed SOE to reply that they were unable to fulfill their own demands, and the suggestion was advanced that the United States should take the British drawings and with British assistance put the device into American production. This was precisely the request which was passed to NDRC on January 5, 1944.

Historical Background

Upon receipt of the problem the assistance of the Engineering and Transition Office was obtained, and this led at once to the arrangement of a contract with the [redacted] a subdivision of [redacted] With arrangements concluded and the program ready to go, OSS most unaccountably lost enthusiasm, and it required further conversations of an extended nature to clarify the OSS decision. This was finally done, and it was decided that: (1) an evaluation of rocket weapons versus Spigot Mortar should be requested of Division 3; (2) British drawings and specifications should be altered for U. S. production and a few models supplied by NDRC, and tooling up for large OSS production was to be deferred; (3) a trial of the effect of the Spigot Mortar against locomotives should take place.

(b)(3) NatSecAct

(b)(3) NatSecAct

(b)(3) NatSecAct

On this more limited basis the [redacted] began active work, and by March had performed their part of the program. In the same month Dr. [redacted] of Division 3 submitted his analysis, which made it obvious that rockets and the Spigot Mortar were complementary and not competing instruments. At the end of March the workers were favored by the visit of [redacted] who had completed the development of the weapon in England.

(b)(3) CIAAct
(b)(6)
(b)(3) CIAAct
(b)(6)

By this time it was clear that adaption of the British invention to American production techniques should not be done blindly. A number of points of improvement became apparent, and the [redacted] proceeded a further complete redevelopment of the weapon. This was favored by the definition of Army Ground Forces, OSS, and Ordnance viewpoints in a conference called early in July. This meeting followed several very large demonstrations which were arranged at MRL by [redacted] and to which liaison officers from all interested Service branches were invited. These demonstrations were sufficiently impressive for a formal request to be received in July from Ordnance and Army Ground Forces for trials at both Aberdeen Proving Ground and Fort Benning, Georgia.

(b)(3) NatSecAct
(b)(3) CIAAct
(b)(6)

The months immediately following were spent in completing the changes from the original British design and in making a sufficient quantity of samples to accommodate the various Services. The Transition Office assigned Mr. [redacted] and OSS assigned [redacted] is to act as expediters.

(b)(3) CIAAct
(b)(6)

In October 1944 part of the original OSS request was fulfilled by firing six live shots at moving and stationary locomotives at Camp Claiborne, Louisiana, with the cooperation of the 756th Railroad Operating Battalion. The result was great damage but not derailment.

During November and December the units requested by OSS were delivered for trial at MRL, and in January the shipment of the requested quantity was made to Fort Benning and to Aberdeen. OSS acceptance of the device was immediate and was greatly influenced by a specific operation planned by General Donovan and General Wedemeyer. The result was a large OSS procurement program intended to supply a team of several hundred agents who were to operate in the interior of China; 1000 sights, 2500 guns, and 12,500 bombs were required. Procurement was facilitated by the transfer to OSS of a number of the tools and dies located at the [redacted]

(b)(3) NatSecAct

A second meeting with Ordnance and Ground Forces was called on January 8, 1945, and it was there decided that OSRD's work was complete unless further requests should arise as a result of the Aberdeen and Fort Benning tests. This did not occur, for both groups decided against the weapon.

OSS production was facilitated in December by Division 1, who studied the internal ballistics of the production models through the courtesy of [redacted] Chief of Division 1, at the Geophysical Laboratory (Contract OEMsr-51). At the same time MRL was drawn into the picture, arranged for trials of the weapon over water in February at the Naval Mine Warfare Station, Solomons, Maryland, and investigated the filling of the bomb head

(b)(3) CIAAct
(b)(6)

with Pentolite, thus settling a point raised by the British who had abandoned the original filling of 808 (a nitroglycerin explosive) and who had questioned that filling of the heads with Composition C2 in the field would be possible. (See MRL Report No. 201 of May 1, 1945.)

By spring OSS had been provided with all reports and equipment, and NDRC withdrew from the problem.

Technical Information

The Tree Spigot Gun is a very light and portable weapon which is capable of throwing a bomb charged with 3.1 lbs. of high explosive to a distance of 250 yds. It is designed for [redacted]

(b)(3) NatSecAct

(b)(3) NatSecAct

Problem Submitted: January 5, 1944. Problem Terminated: June 8, 1945.

Contract: OEMsr-1279 with [redacted] official investigator; Jan[redacted] to February 28, 1945. (b)(3) CIAAct (b)(3) NatSecAct (b)(6)

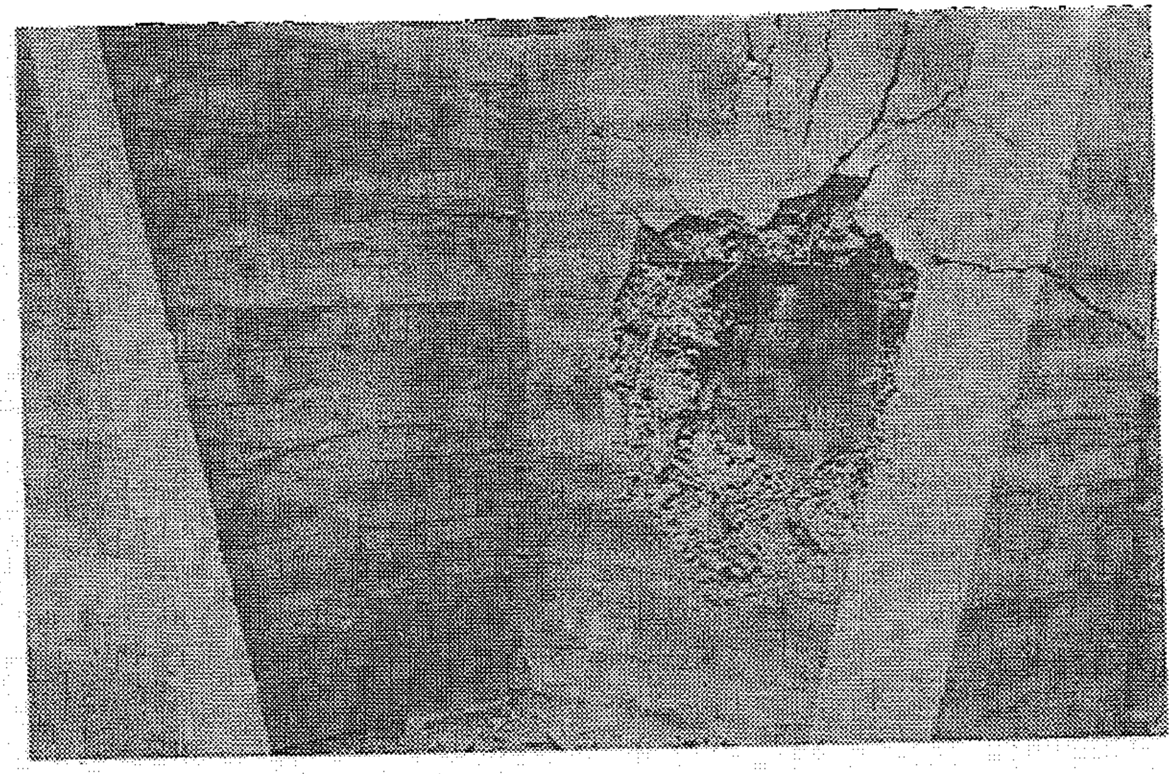
Final Report: Division 19 Serial No. 26 submitted to [redacted] on March 3, 1945. (b)(3) CIAAct (b)(6)

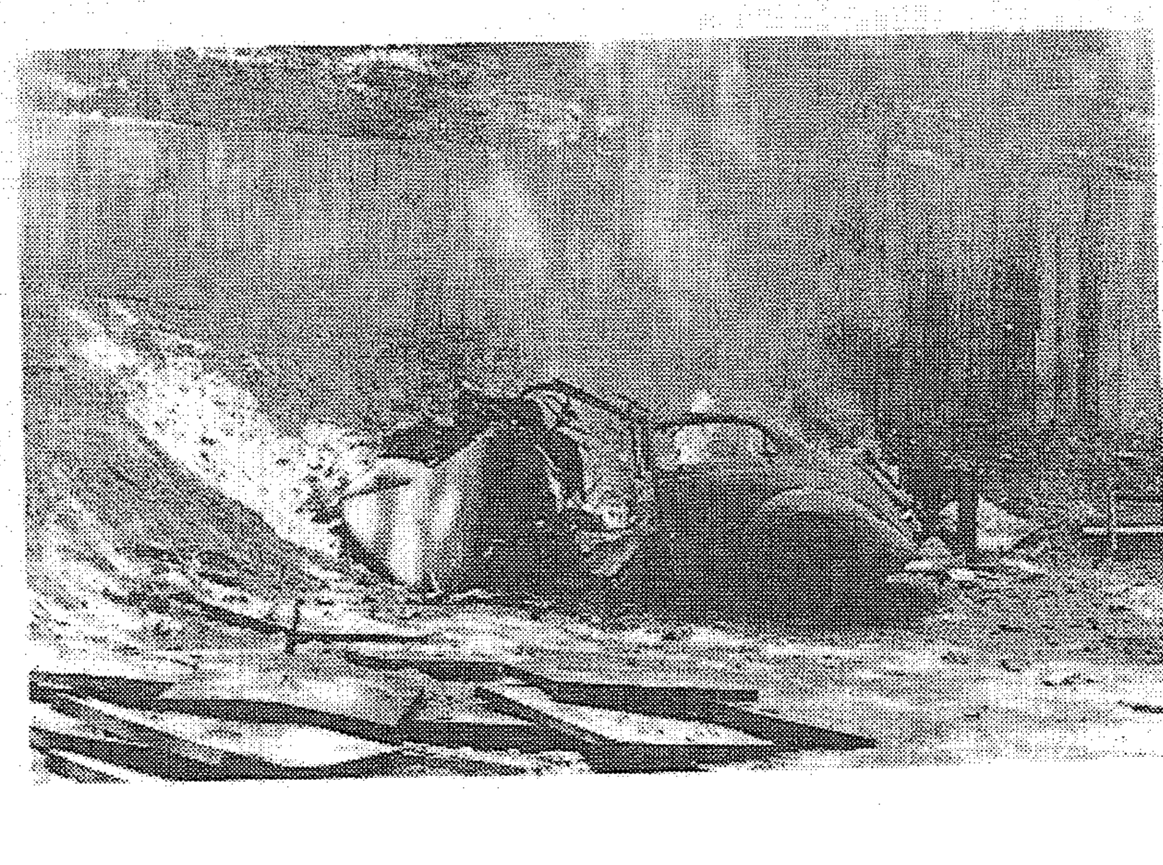
Patent Report: Forwarded to Captain [redacted] on June 23, 1945. (b)(3) CIAAct (b)(6)

(b)(3) NatSecAct

[redacted]

(b)(3) NatSecAct





Classification: ~~Secret~~

SAC-37 CRICKET

Operational Background

Although both SOE and OSS had large research groups which had developed a number of radio sets, they felt the need of a low-powered transmitter of minimum size which they visualized distributing throughout Europe prior to D-Day for the transmission of intelligence.

General Statement of the Problem

[redacted]

(b)(3) NatSecAct

Historical Background

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct
(b)(3) CIAAct
(b)(6)

Immediately on receipt of the problem it was transmitted to Division 13 who presented it to a number of commercial firms with the result that by February 1944 Lt. [redacted] of OSS was in direct contact with the [redacted] Since Division 13 was not interested in problems which were considered mere assembly jobs, the problem was handled entirely by [redacted] henceforth.

Problem Submitted: December 18, 1943.

Problem Terminated: March 16, 1944.

Classification: Secret

SAC-38 MEMO

Operational Background

Although there seemed practically no likelihood of being about to carry out sabotage against enemy submarines, OSS nevertheless submitted the problem with the hope that if some startling discovery were made, operational groups would make use of it.

General Statement of the Problem

It was suggested that the battery water and the air conditioning systems would be vulnerable, but a free hand was given in the methods to be explored.

Historical Background

The problem was immediately assigned to MRL, and they were provided with British Laboratory Contribution No. 58 entitled "Attack on U-Boats." This interesting document described a German submarine which was captured intact in the English Channel in 1943 and gave an analysis of the vulnerable points as appraised by SOE in England. The information was considered of value to commando groups making sneak raids on French ports.

MRL secured permission for a visit to Portsmouth, N. H., by [redacted] where American submarines were inspected. From this it appeared that the following lines of attack were promising: (1) Limpet attack initiated by a Concussion Detonator which would respond when the submarine dived. (2) Attack on the propeller shaft by a Ring Charge (see Varga, SAC-35). (3) Attack on the bearings of the propeller shaft by shaped charges. (4) Contamination of the battery water. (b)(3) CIAAct (b)(6)

Only suggestions (3) and (4) received active study. Suggestion (3) resulted in MRL Report No. 139 of August 23, 1944, which indicated that the Fountain charge would be effective. Suggestion (4) resulted in two reports by [redacted] MRL Reports No. 137 of September 14, 1944, and No. 148 of October 14, 1944, which confirmed the work previously reported under Shortstop (SAC-25). (See MRL Report No. 42 of February 1, 1944.)

(b)(3) CIAAct (b)(6)

Technical Information

1. Bearing Attack.

It was found that the Fountain charge (cf. SAC-10) would penetrate 6 in. of steel when used with a 1-in. standoff at a water depth of 6 ft. It was also demonstrated that the charge was waterproof. The charge consists of a steel shell of 0.090 in. thickness, 4.-in. diameter, filled with 2.5 lbs. of 55-45 Pentolite and having an 80° angle cone.

2. Battery Attack.

[redacted]

(b)(3) NatSecAct

Problem Submitted: February 9, 1944. **Problem Terminated:** September 19, 1944.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Contract: OEMsr-955 with [redacted] and [redacted] official investigators.

Final Report: MRL Report No. 139 of October 23, 1944, and MRL Report No. 148 of October 14, 1944.

Patent Report: No inventions were made.

SAC-39 LOCUST

Operational Background

It was thought that sabotage of machine shops could be readily accomplished by subtle means if agents could be supplied with some simple device which would spread corrosive fumes.

General Statement of the Problem

(b)(3) CIAAct
(b)(6)

(b)(3) NatSecAct

The suggestion was made first by [redacted] Chief of Division 11 and President of [redacted] as follows:

> "As you know, I have been intrigued for a long time with the possibility of using corrosive gases on industrial targets and certain types of military installations, and as a possible reagent, have passed along the suggestion of [redacted] with [redacted] No experimental work has been done, although all of us who have worked around the laboratory have had experience that would indicate the possible value of such reagents."

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)
(b)(3) NatSecAct

A study was requested on all types of corrosive material with the thought that if they were not detected at once serious rusting and pitting of fine machinery would result, and if they were detected much time would be lost in cleaning the machinery.

Historical Background

(b)(3) NatSecAct

The problem was assigned to [redacted], under their existing contract, and work continued until June 15, 1944, with the cooperation of the [redacted] group. By that time sufficient work had been done to show that the idea was not practical, and the problem was terminated.

(b)(3) NatSecAct

Technical Information

A search of 42 corrosive compounds indicates that it is fairly simple to corrode steel surfaces severely, but the quantity of corrosive which would be necessary to treat a small factory room (10,000 cu.ft.) would be contained only in a rather large package. Using bromine, the most powerful liquid corrosive tested [redacted] would be needed, and of the solid corrosives such as the [redacted] would be needed.

(b)(3) NatSecAct

In addition, all solid corrosives are felt to be slow in their reaction and difficult to disperse. These figures are based upon the assumption that the means of dispersion would be such as to distribute the material more or less uniformly about the room. It was not forgotten that bromine is a chemical warfare gas which would remove it from consideration.

Another factor which makes the picture even more discouraging comes from the fact that grease films seem to protect surfaces very effectively.

Problem Submitted: March 8, 1944. **Problem Terminated:** July 6, 1944.

Contract: OEMsr-1023 with [redacted]; May 24, 1943, to June 30, 1945. (b)(3) NatSecAct

Final Report: Division 19 Serial No. 22, Part II, dated December 27, 1944, submitted to [redacted] on October 4, 1945. (b)(3) CIAAct (b)(6)

Patent Report: No inventions were made.

Classification: ~~Secret~~

SAC-40 LACRIMA TOJO

Operational Background

Mr. Lovell believed that it might be simpler to blow up an automobile with high explosive than to destroy it subtly with Caccolube (SAC-9). The need for a variety of methods of attack on automotive equipment was obvious.

General Statement of the Problem

(b)(3) NatSecAct

It was known that both Division 8 at the [redacted] and the [redacted] had developed liquid explosives, and it seemed possible that these materials could be suitably camouflaged and introduced into gasoline storage drums or automobile fuel tanks. Since these liquid explosives derived their insensitivity from additives, the possibility existed that extraction of the additive by the gasoline would leave an extremely sensitive explosive residue. It was assumed that the explosive base would be insoluble.

(b)(3) CIAAct
(b)(6)

Historical Background

(b)(3) NatSecAct

Upon receipt of the problem it was suggested that Division 8 might handle it, but [redacted] Chief, felt that the work could better be done by Division 19 at MRL. Division 8, however, was glad to provide samples and to give information. This they did in April when a quantity of [redacted] was shipped. At the same time the [redacted], through [redacted] provided information on their product and gave advice to [redacted] at MRL, who was in charge. This advice was all negative and cast such serious doubt on the practicability of the proposal that OSS withdrew.

(b)(3) NatSecAct

(b)(3) CIAAct
(b)(6)

The questions and answers which resulted in this decision are as follows: "Assuming a quantity of about [redacted] is added to a 50-gal. drum of gasoline,

(b)(3) NatSecAct

1. What are the chances of explosion of this drum from the rough handling that may be expected in transport?

   Answer. Even assuming what would appear to be the worst possible case, the chance of detonation would be extremely remote.

2. If a quantity of just the gasoline phase in the drum is transferred to the gas tank of a truck or plane, what behavior might be expected?

Answer. [redacted] (b)(3) NatSecAct
It is a certainty that it would not detonate when drawn into an engine in this manner.

3. If in transferring the contents of the drum to the truck or plane a quantity of [redacted] gets into the tank, what are the chances of detonation as it flows through the gasoline feed lines and into the cylinder? (b)(3) NatSecAct

Answer. If it were drawn into the carburetor it would merely cause stoppage of the engine. Assuming it is carried beyond into the manifold and into the cylinders, there is some chance of detonation. It is much more likely, however, that the heat will cause decomposition [redacted] but that detonation will not result. (b)(3) NatSecAct

"Assuming that [redacted] is in the crank case of an engine, (b)(3) NatSecAct

4. What are the chances of detonation of this from heat friction or churning?

Answer. Engine oil is a very effective desensitizer. It is our opinion, therefore, that there is only a slight chance of detonation." (b)(3) NatSecAct

(b)(3) CIAAct

Some further work was attempted at MRL on camouflaging [redacted]. For this purpose dyes were obtained from [redacted] with the thought that a product resembling lubricating oil might be obtained and liquid explosive thus smuggled into occupied territories (cf. SAC-16). Unfortunately, it was found that [redacted] on which the explosives were based destroyed the dyes. (b)(3) NatSecAct (b)(6) (b)(3) NatSecAct

Technical Information

[redacted] (b)(3) NatSecAct

Problem Submitted: May 18, 1944. Problem Terminated: July 1, 1944.

Contract: OEMsr-955 with [redacted] (b)(3) NatSecAct

Final Report: MRL Report No. 125 of August 24, 1944.

Patent Report: No inventions were made.

SAC-41 VERITAS

Operational Background

The OSS operational picture was given as follows: "One of our airplanes scouting over enemy country, preferably at night, throws out delayed action flares at various intervals. Later in the night or the next night they will be activated to send up various colors of Very lights all for the purpose of misleading the enemy, of indicating guerilla forces giving signals where no guerilla forces exist, or possibly acting as night markers for following targets."

OSS pictured these operations as taking place in dense jungles in Burma. SOE had a similar operational requirement, but it was a matter of very low priority to them and they took little interest in the problem.

General Statement of the Problem

Immediately upon receipt the problem was assigned to MRL, and within two months two preliminary models were ready for trial. One type contained the Very cartridge mounted on a spike which in theory would be driven into the ground by the force of the impact and would securely hold the device in an upright position. The other model was hemispherical and so weighted that it would roll into an upright position on reaching the ground. The first drop tests conducted from an airplane in July 1944 showed that the spike model was quite unsatisfactory, being very susceptible to the nature of the terrain.

The bowl model however appeared reasonably suitable and was thenceforth the prototype on which future work was based. In its earliest form it consisted of a breach tube which was soldered to the bottom of the bowl on the inside and held the upright Very cartridge to which was taped a time delay Pencil.

To cushion the shock of landing and to prevent the cartridge from firing at once, a small lump of plasticine was inserted in the base of the breach. This device was fully described in MRL Report No. 111 of July 24, 1944, and appeared so promising that at OSS request MRL proceeded to procure 500 models to demonstrate the performance of the device. The first assembled units were subjected to airplane trial at Beltsville, Maryland, on December 15, when they were thrown from an aircraft at speedsvarying between 100 and 200 mph and at altitudes between 1000 and 2000 feet. The result was very disappointing. Many of the units fired on impact and others were broken up by the shock. The MRL group under [redacted] greatly strengthened the critical parts and a further drop test was held on January 30, 1945. The unit was shown to be inadequate, and it appeared that the lump of plasticine was a handicap rather than an assistance.

(b)(3) CIAAct
(b)(6)

With the omission of this and with some further modification of the mounting for the cartridge and Pencil, further trials took place in March which were on the whole fairly successful. At that time it appeared that the critical point was the time Pencil which bore up poorly against the impact. This was confirmed by further tests in May which showed that the tension wire in the time Pencil tended to break or slip, and it appeared that this could not be corrected unless the terminal velocity of the Veritas unit was materially reduced. The idea of cloth trimmers, so successfully used in the M-69 bomb, was thereupon incorporated, and on June 22, 1945, a moderately successful demonstration was performed.

By this time, however, the Service interest which had never been very strong completely disappeared, and the problem was concluded with only a partially successful solution.

Technical Information

The standard Very cartridge consists of a 6-in. fiber board tube with 1-1/2-in. outside diameter, 13/16-in. inside diameter, and a metal cap or base covering the tube at one end for a distance of 1-1/2-in. Compression of the metal end by the trigger in the Very pistol fires the signal; in Veritas, however, it is desired that the cartridge not fire on impact but rather by the action of a delay Pencil.

This required the development of a satisfactory waterproof initiating system. It consists of a small non-erratic blasting cap crimped to a 3-inch length of safety fuse waterproofed with beeswax. The special blasting cap was made by the [redacted] and contained 3 g. of 80-30 (b)(3) NatSecAct mercury fulminate-potassium chlorate. This initiation train connects the spring snout of the standard time Pencil to the base of the Very cartridge. The cartridge and the Pencil are taped together and inserted in a socket which is screwed directly into the bottom of a hemispherical steel bowl of 4-1/4-in. internal diameter. Cloth trimmers of 4-ft. length are attached to the outer rim of the bowl, and the whole unit weighs 11.7 oz. By selection of the proper colored Pencil a variety of functioning times is obtained.

Such a unit falls at the rate of about 75 ft./sec. and has at least a 75% chance of surviving impact with firm, grassy ground at this speed.

Problem Submitted: April 4, 1944. Problem Terminated: June 8, 1945.

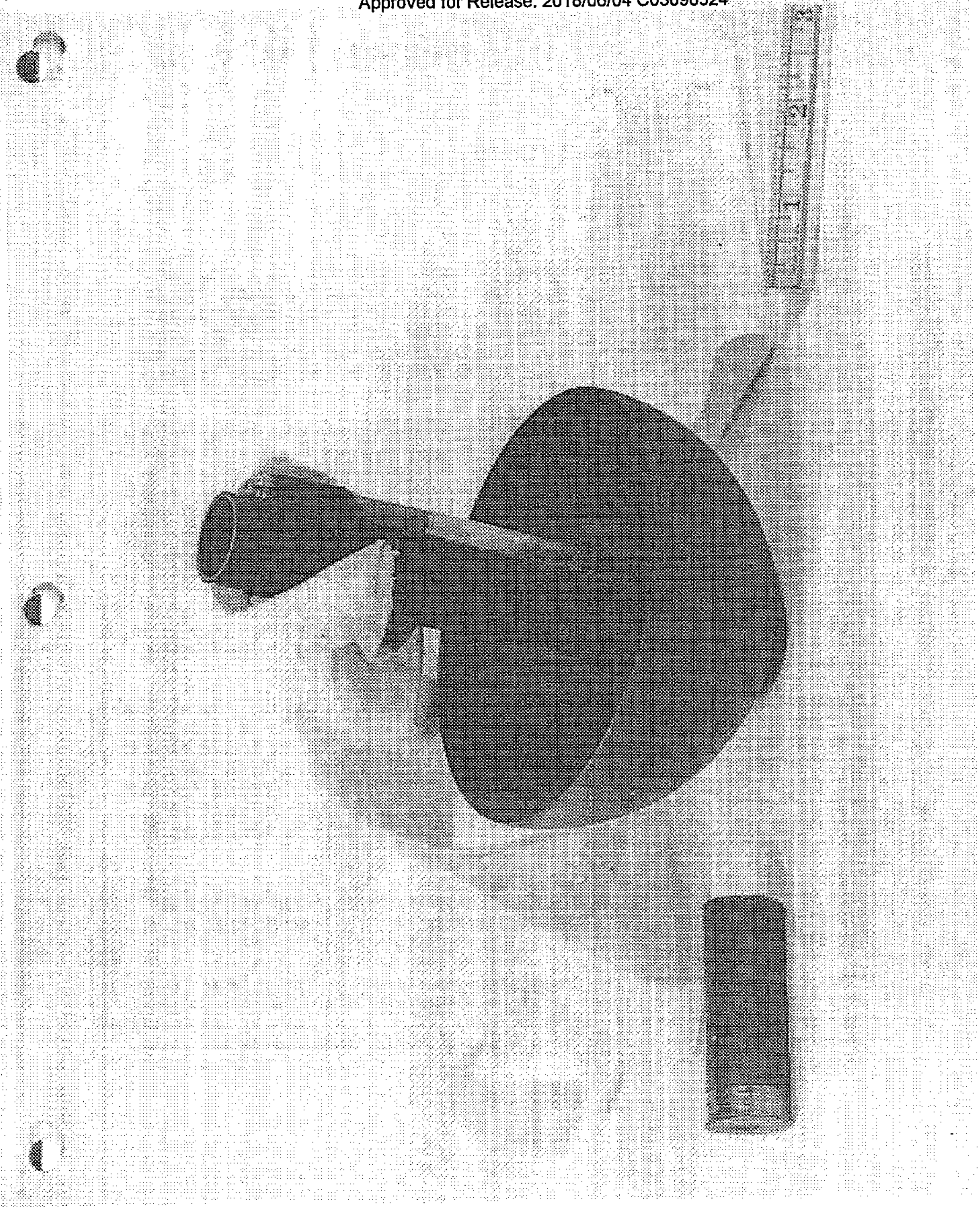
Contract: OEMsr-955 with [redacted] official investigator.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Final Report: MRL Report No. 111 dated July 24, 1944.

Patent Report: Invention report forwarded to Captain [redacted] on April 11, 1945.

(b)(3) CIAAct
(b)(6)



Approved for Release: 2018/06/04 C03098524

Classification: ~~Confidential~~

SAC-42 LIMPETRY

Operational Background

One of the methods of attack which proved most profitable was the use of Limpets against merchant shipping. This type of attack apparently originated in the Revolutionary War when some enterprising Americans attacked British ships by detonating against their sides large barrels of gun powder. As in all forms of warfare, considerable progress had been made, and with the discovery of high explosives much smaller devices became possible and were of great effectiveness.

At the beginning of World War II, SOE very quickly produced a small device operated by underwater time delays and equipped with magnets for attachment to metal ships. By the time that OSS had been organized, the British Limpets had gone through several modifications and a very elaborate underwater research program was in full swing in England. This included such interesting devices as the Sleeping Beauty already mentioned in SAC-4, a self-propelled automatic Limpet, and a variety of equipment designed to give an agent security and maximum performance, both above and under water.

In addition to this British activity, it was known that the Italians were especially interested in this field and had crafts and agents comparable to the British operating in the Mediterranean with some effect. The Germans at the same time were not far behind.

It seemed desirable that an American research program along the general lines of Limpetry should be undertaken, although it was recognized that this would consist largely of clearing up a number of loose ends not previously covered by problems SAC-3 (Pin-Up and Magnets), SAC-10 (Sympathetic Fuze), and SAC-31 (Teak). The urgency and value of such a program was continually apparent to all from the recurring newspaper accounts of successful operations of this type. For interest, the following excerpt from the New York Times of April 23, 1945, is quoted.

"Saboteurs blew up four ships and a lighthouse in Oslo Harbor at 6 o'clock this morning, according to the local correspondents of the Nazi-operated STB news agency. Foreign workers employed in the harbor are being blamed for the disaster.

"Two of the ships where the German 3,000-ton vessel Ortelsburg, which foundered quickly, and the Norwegian 5,500-ton Tugela of the Wilhelmsen Shipping Company, which is now partially submerged. Other ships owned by the Norwegian-American line and the Thor Thorsen Shipping Company respectively are still afloat, although badly damaged.

"The German Commander of the Bergen naval district announced today that all ships, regardless of size, must halt at the risk of being fired on or sunk whenever they are approached by German war vessels or German merchantmen with military crews."

General Statement of the Problem

It was desired that Division 19 should carry through the testing and proving stage the various improvements which had resulted from work on the three SAC problems mentioned above and to demonstrate that the American production of the Limpet was satisfactory for OSS and SOE use.

Historical Background

The problem was assigned to MRL and covered a number of fairly distinct subjects which will be treated separately below.

1. American Limpet.

OSS had, because of the shortage of brass in this country, decided to abandon the standard British Limpet construction which was very consuming of that metal. Using the British design but substituting celluloid for the Limpet body and bracketed side arms, OSS was able to produce very cheaply and quickly thousands of Limpets which they and SOE would have been unable to acquire in any other way. The resistance of these new cases to rough handling, humidity, and temperature changes was a matter of some importance and was shown to be satisfactory in MRL Report No. 181 of February 10, 1945.

2. Explosive Filling.

The British custom in using Limpets was to supply them empty to the field, where the operator would fill them with plastic explosives. Unfortunately celluloid was not compatible [redacted] and a selection of a new filling was therefore required. With the cooperation of OSS the best filling was determined [redacted] This material was known from Division 2 work to be most effective under water, while at the same time being shown to have complete stability in contact with celluloid. As a result of this selection OSS procured the necessary cast [redacted] blocks from the Hastings, Nebraska, Ordnance plant of the Navy. Complete safety of the [redacted] filled Limpet to rifle fire was demonstrated at MRL.

(b)(3) NatSecAct

(b)(3) NatSecAct

(b)(3) NatSecAct

(b)(3) NatSecAct

3. Attachment.

The larger part of the OSS production was provided with magnets of the type described in SAC-3. Some 5000 Limpets, however, were made with Pin-Up attachment, and it was requested that MRL demonstrate that the operation of the Pin-Up would not initiate the [redacted] charge and would

(b)(3) NatSecAct

not be detrimental to the ears of a swimmer under water. MRL Report No. 147 of October 13, 1944, clarified the first point and No. 119 of August 1944 clarified the second.

4. Placing Rods.

From time to time MRL performed tests with different designs of placing rods produced and submitted by OSS. No original work was, however, done by NDRC.

5. Sympathetic Fuse.

The possibility existed that a Pin-Up on firing might cause a Sympathetic Fuse on the same Limpet to function. The point was fully answered by MRL Report No. 85 of May 12, 1944, which showed that even overloaded Pin-Ups would not cause this to happen so long as the salt block remained undissolved in the Sympathetic Fuse.

6. Flotation Chambers.

An operator placing Limpets from a kyak or rowboat was not concerned over the weight of the standard Limpet which with attachments came to nearly 10 pounds. However, a man operating under water was concerned, and it was desired that the Limpets should be buoyed so as to be nearly neutral in water. This was successfully accomplished, and the details are given in MRL Reports 165 of December 28, 1944, No. 175 of February 2, 1945, and No. 221 of July 4, 1945.

7. Effectiveness.

Although the British had sufficient data to prove that the Limpet as designed was extremely effective in its use on steel ships, it was not clear what effect a Limpet would have on wooden vessels. This question was answered by a series of experiments at MRL in which wooden replicas of ship side construction were attacked by Limpet charges placed at the proper depth of 5 feet (cf. SAC-31). This was possible because the MRL explosives area was provided with a dam having a large opening which could be covered by these test structures and which was backed by water on one side. From these experiments it appeared that the construction found in the usual small boat of not more than 100 feet would be vulnerable to Limpet attack. This was confirmed by experiments at Hopewell, Virginia, in May 1944 when Limpet attack on heavy wooden barges showed that a single Limpet would produce an opening in the ship's side of approximately 15 square feet. Full details are reported in MRL Report No. 93 of June 6, 1944.

On July 14, 1944, when the Sympathetic Fuses (SAC-10) were given their final trial in Baltimore Harbor on the Gaspar di Partola, two Limpets were detonated. The results entirely confirmed the previous British information, each

Limpet producing a tear in the steel plates of approximately 20 square feet (see MRL report No. 110 of July 19, 1944). These latter experiments were of great value and interest to the David Taylor Model Basin of the Navy, and personnel of that laboratory frequently used the MRL facilities and invariably attended the experiments.

Technical Information

The accompanying illustration and sheets from the OSS Catalog of Weapons are felt to be fully informative. The MRL reports referenced contain all the pertinent details.

Problem Submitted: April 14, 1944. Problem Terminated: June 30, 1945.

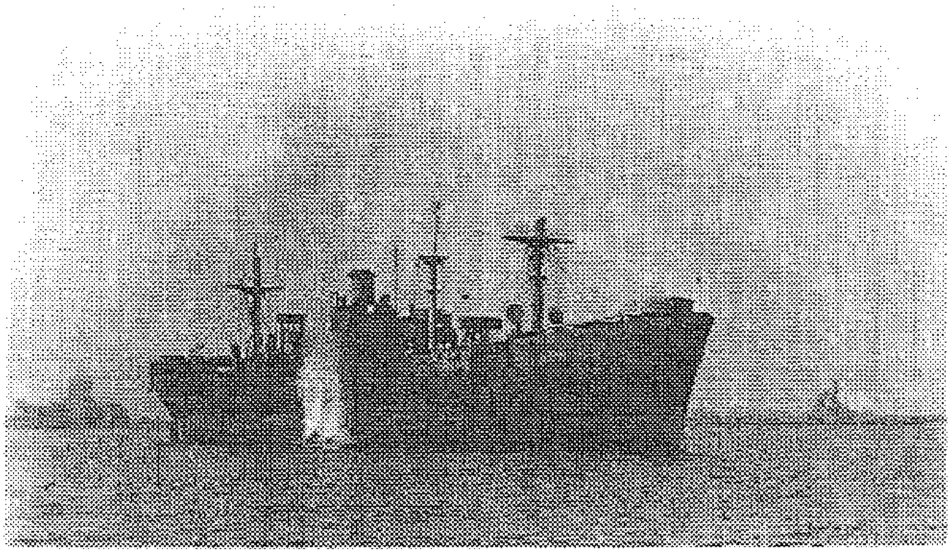
Contract: None

Final Report: None

Patent Report: No inventions were made.

Approved for Release: 2018/06/04 C03098524

(b)(3) NatSecAct



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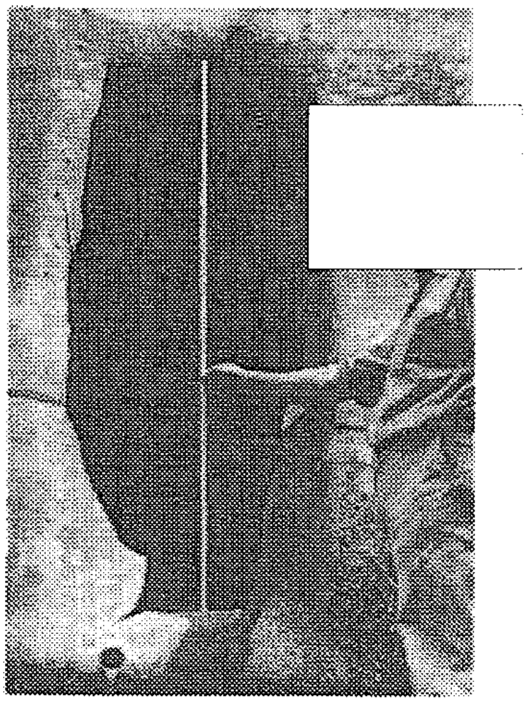

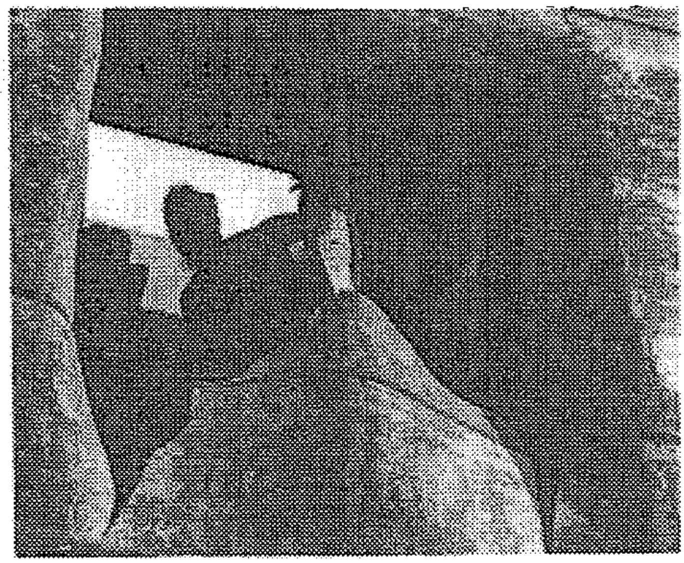

Classification: ~~Secret~~

SAC-43 BALSAM

Operational Background

"In various operations of secret agents it is exceedingly important to be able to dispose of written matter promptly and with a minimum of equipment." Two requests were submitted of this type: SAC-43, in which it was proposed that the problem could be satisfied by a paper readily destroyed by immersion in water or mastication; and SAC-47, in which the requirement was to be met by the production of a notebook readily destroyed by explosive or incendiary means. These were two aspects of the same problem but in operations did not duplicate each other.

It was said that a secret agent would receive his personal instructions on a single sheet of paper. This he would carry with him as a reminder at all times, but in the event of capture he would wish to destroy it with minimum difficulty. The Balsam problem was of this type. The Moth problem was intended to provide him with notebooks in which he could record his discoveries and which would therefore be more voluminous. This also would be readily destructible in case capture were imminent.

General Statement of the Problem

Development was requested of a suitable paper which would allow ink and pencil writing, or typing on both sides, would be light weight, resistent to humidity and adverse storage condition, would have fair strength and durability, but would be rendered illegible by immersion in water or mastication.

Historical Background

When the problem was submitted it was pointed out that two partial answers existed, namely British "soluble paper," consisting of a cast pigmented film [redacted] (b)(3) NatSecAct Division 19 and was known to be expert in this field, the problem was assigned to that laboratory.

The results were immediate, and by May 1944 the first samples of special paper were received and submitted to OSS for appraisal. [redacted] (b)(3) NatSecAct [redacted] During June it was demonstrated that this special paper had good resistance to humidity and contained no materials which were toxic. It was

recognized that the flavor [redacted] was, however, not attractive, and t (b)(3) NatSecAct improve the demand. further samples were submitted in July which contained added [redacted] samples were well liked, and in (b)(3) NatSecAct September OSS received final specifications and the names of suggested manufacturers.

After long and fruitless negotiations, OSS appealed to NDRC to produce its order of fifteen reams for full scale field appraisal. This was done under the [redacted] contract by purchase order with the [redacted] (b)(3) NatSecAct

(b)(3) NatSecAct [redacted] MRL tests of both the first samples ar the final product showed it to be entirely satisfactory (see MRL Report No. 128 of August 29, 1944, and No. 200 of May 1, 1945).

Technical Information

[redacted]

(b)(3) NatSecAct

Problem Submitted: April 18, 1944. Problem Terminated: March 22, 1945.

Contract: OEMsr-1023 with [redacted] (b)(3) CIAAct (b)(3) NatSecAct (b)(6) official investigator; May 24, 1943, to June 30, 1945.

Final Report: Division 19 Serial No. 22, Part III, submitted to (b)(3) CIAAct (b)(6) [redacted] on October 4, 1945.

Patent Report: Forwarded to Captain [redacted] on October 20, 1944.
(b)(3) NatSecAct (b)(6)

(b)(3) NatSecAct

Classification: ~~Secret to~~ ~~Confidential~~

SAC-44 BELCHER

Operational Background

It was thought likely by OSS that the Japanese would have laid plans for the sabotage of American city water supplies. Accordingly, they suggested that some work of an entirely defensive nature should be performed on compounds which in traces or parts per million or less would render drinking water unpalatable although not poisonous. As a result of this study, American operations of a similar type against Japanese were foreseen.

General Statement of the Problem

The problem was framed in a very general manner, although a specific substance, namely the bitter principle of the wood of quassia amara was suggested. Since this principle, named Quassin, was of unknown chemical structure and was exceedingly difficult to isolate, on the advice of Dr. Roger Adams and Dr. J. B. Conant the problem was accepted in its broadest aspects to include all known toxic chemical agents which might be added to drinking water to render it unpotable. Methods of decontamination were sought as well.

Historical Background

Prior to formal submission of the problem, conversations took place between Mr. Lovell, Dr. Chadwell, and [redacted] of the Sanitary Corps of CWS at Edgewood Arsenal. [redacted] suggested that [redacted] and connected with Division 9, would have information on a possible material, the odorous principle of [redacted] This suggestion was followed by a visit which [redacted] of Mr. Lovell's staff paid to [redacted] in March 1944, at which time [redacted] agreed to synthesize and measure the potency of a number of specific substances.

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(b)(3) NatSecAct
(b)(3) CIAAct
(b)(6)

Upon receipt of the problem in May, Division 19 requested Division 9 to assume responsibility, and this was done by their instruction to [redacted] to proceed with the program sketched out with [redacted] The result was an informal report submitted on June 24, 1944, on a number of water denial agents which were effective in concentrations of about one part per million. All the materials tested were found less effective than [redacted] but on the other hand much more available, and OSS then considered the possible offensive use of this information.

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct

Before putting it to field trial, however, an arrangement was made by OSS for an experiment to determine whether water so treated, and which was most nauseating to white men, was offensive to Orientals. A group of Japanese prisoners of war were supplied without comment with some of this specially treated water after they had performed arduous labor and were very thirsty. Much to the surprise of all, the Japanese received the water with relish, apparently being unaware of the added chemicals. This discouraging outcome ended the problem. Methods of decontamination other than charcoal treatment were never explored.

Technical Information

[redacted]

(b)(3) NatSecAct

Problem Submitted: May 12, 1944.

Contract: Work was done at the [redacted] under a Division 9 contract.

(b)(3) NatSecAct

Final Report: The final report was an informal report, No. 104, of Division 9 b[redacted] dated July 18, 1944.

(b)(3) CIAAct
(b)(6)

Patent Report: No inventions were made.

SAC-45 MAUDE MULLER

Operational Background

"Irregular troops in jungle warfare are unable to advance over flat terrain because immediately following the monsoons it has a growth of high, lush grass and rank vegetation. In such cover a few Japanese soldiers in fox-holes present an unsolved obstacle. Actually tanks have been tried as the only possible means of advance of our troops over such topography, but the tanks are vulnerable to Molotov cocktails and clams. Many attempts have been made by Operations people to ignite the grass, since this attack would completely solve the problem. No success has been met to date. Experts on the subject of forest fires have pointed out that once a sufficient ignition is achieved the green vegetation with a high water content is dehydrated by the advancing flame and that therefore the problem is capable of solution."

General Statement of the Problem

In light of the above, the problem was as follows: Development of a means of igniting heavy, green vegetation such as grass or reeds to the point of preventing the enemy from hiding in it. This was to be done with the mini-mum equipment both as to weight and intricacy.

Historical Background

That the reports reaching OSS were correct was apparent from the number of similar reports circulating in the regular Services and arriving from the British. Wherever the water table in certain regions of southeastern Asia reaches the surface, kunai and lalong grasses rapidly reach a height of 8 feet. Burning of these regions in the dry season is possible, but the roots and rhizomes are little affected and with a change of season the region rapidly grows over again. Field trials with all standard military incendiaries, [redacted] were found to be without effect. (b)(3) NatSecAct

Upon receiving the problem in July 1944, contact was made with experts of the [redacted] to learn which native grasses would most closely approximate Elephant Grass with the object of conducting experiments in this country. [redacted] advised that no single native grass would exactly duplicate Saccharum arundinaceum and Saccharum spontaneum, the scientific names for Kaing or Elephant Grass. They thought that experiments should be conducted on silage corn and Phragmites communis,

(b)(3) NatSecAct

(b)(3) CIAAct
(b)(6)

a tall grass found in abundance on the eastern seaboard of the United States and very common on the New Jersey marshes. These two plants between them had the root and stem systems of the true Elephant Grass.

In August, OSS pointed out the CWS activity which was centered at Camp Detrick, Maryland, and on October 6 MRL and Division 19 representatives called on [redacted] to discuss with him their work on defoliation. (b)(3) CIAAct (b)(6) It should be said that by this time OSS had become convinced that the problem could not be solved by straight incendiary attack, since the vegetation contained more water than could be vaporized by the heat which would result from complete combustion. A self-sustaining fire would therefore be an impossibility. Hence the Camp Detrick work on defoliation came into prominence and OSS was willing to consider plant poisons which would kill and wither the leaves, making them susceptible to incendiary attack after a few days of drying out. The Camp Detrick conversations led to a small trial there of the effect [redacted] on sorghum. (b)(3) NatSecAct The results were not promising.

At about the same time the Weather Bureau gave information to Division 19 on the humidity of the whole region where Elephant Grass was found. It appeared that even in the dry season the relative humidity in general seldom fell below 75 percent, so that even if the grass should be killed it appeared unlikely that it would dry out for long periods of time.

OSS accepted this information as sufficient to show that the problem was impractical, and it was accordingly terminated.

Problem Submitted: June 23, 1944.

Problem Terminated: November 7, 1944.

Contract: None.

Classification: Secret

SAC-46 FLYING DRAGON

Operational Background

The ever present need in OSS operations for silent and flashless weapons has been thoroughly discussed before under the following problems: SAC-1, SAC-13, SAC-14, and SAC-36. The first three of these called for work which would lead to a silent hand weapon employing a coiled spring, rubber, or silencer respectively. One other method of propulsion was possible, namely the use of compressed gas. Of this type two preliminary models of different designs had already been partially worked out independently by OSS. The first was capable of throwing a slow, heavy missile [redacted] and the second was capable of throwing a light missile with considerable muzzle velocity [redacted]

(b)(3) NatSecAct

(b)(3) NatSecAct

General Statement of the Problem

It was desired that NDRC should complete these developments and rework them to provide a weapon of minimum size and compactness. The missile thrown was to be a dart having a detachable head which would "permit sensitization" in the field. It was doubted by NDRC that such a missile could be effective without the use of poison and with this limitation the problem was not an acceptable one.

(b)(3) CIAAct
(b)(6)

[redacted] did not approve it in its original form, and it was never submitted again. OSS, however, continued its own work and eventually produced a working model of the second type.

Problem Submitted: July 27, 1944.

Problem Declined: August 11, 1944.

Contract: None.

Classification: ~~Secret to~~
~~Confidential~~

SAC-47 MOTH

Operational Background

Prior to submission of the problem by OSS, CWS at Edgewood Arsenal had expressed the need of a device which could be inserted in standard messenger pouches and would accomplish the destruction of cryptographic sheets, field manuals, and similar documents of interest and value to the enemy. Operation was to take place automatically when the pouch was opened by a person unfamiliar with its use. Somewhat similar operational requirements existed in both OSS and SOE, who had numbers of agents operating in German territory.

In spite of the work which had been done by both CWS and SOE, OSS did not feel that the problem had been satisfactorily answered for their purposes and therefore requested that Division 19 complete the development.

General Statement of the Problem

As presented by the secret intelligence and operating groups of OSS, a requirement existed for three different sizes of document destroyers. The first of these was a small case which could be camouflaged as a fountain pen or shaving kit or similar personal item which would be large enough to hold two or three sheets of folded paper and which would destroy them in 30 seconds upon initiation. The second device was a medium case in the form of a notebook with bound sheets of ordinary paper which could similarly be destroyed. In addition, for this size the requirement existed that the device should operate when thrown from an airplane and be consumed before or shortly after reaching the ground. The third requirement was for a large case replacing or insertable in a standard briefcase and capable of destroying a thick packet of loose reports and maps.

There was a very small but vocal demand for all of these sizes, and it should be stated that the problem is not as simple as might appear, for the destruction of paper in bulk has been the problem of all intelligence agencies for years past.

Historical Background

(b)(3) CIAAct
(b)(6)

During a visit to Edgewood Arsenal in September 1943, [redacted]
(b)(3) NatSecAct [redacted] became aware informally of the CWS requirement for a messenger pouch destroyer. A letter requesting active work and dated September 29, 1943, was received from Brigadier General W. C. Kabrich, and

[redacted] proceeded in the next three months to modify the Pocket Incendiary case and ignition mechanism to give an answer to the problem. His report of December 21, 1943, apparently closed the matter to the satisfaction of CWS. Their full report on the subject, TDMR-949, of January 6, 1945, entitled "Messenger Pouch Destroyer E5" recommended the standardization of a device very similar to the one presented [redacted]

This device was fully known to OSS, but in their opinion it did not meet the requirements stated above. Accordingly, the problem was reopened in July 1944 and a conference of the interested parties was immediately held with MRL receiving the assignment and commencing work. This took the line of explosive attack, which they felt better qualified to handle than incendiary attempts.

At their suggestion, on October 10, 1944, the incendiary aspects were removed from MRL and were handled thenceforth by [redacted] working with [redacted] on SAC-6. At the same time the [redacted] workers were supplied with full details of the extensive previous British work which had resulted in a number of models (deed box, suit case, attache box, and briefcase) all based on thermit and accessory quilts filled with potassium nitrate. The latter chemical supplied an excess of oxygen for the combustion of the paper and converted the carbon in it to potassium carbonate. Some of these British devices had automatic initiation unless special precautions in opening the case were observed. All of them, however, were very heavy, cumbersome, and uncertain in their initiation so that very little assistance was gained from this previous experimentation.

The MRL explosive work proceeded smoothly, and on November 2, 1944, a briefcase size explosive unit was demonstrated before a large group of OSS personnel. This was later fully described in MRL Report No. 173 of January 22, 1945, and was accepted in essentially that form by OSS for limited procurement. Work of a very similar nature on the small and medium size explosive units was completed by the spring of 1945 (see MRL Report No. 202 of May 4, 1945).

The work [redacted] proceeded also with success, and in November and December [redacted] demonstrated small notebooks of the loose-leaf spiral type, the paper pages being interleaved with sheets of Pyrofilm, a composition of celluloid and sodium nitrate. Both he and MRL had to devise separate and new initiation systems with [redacted] basing his upon the standard time Pencil and [redacted] at MRL basing his upon a pyrotechnic delay with lead azide detonation.

As a result of OSS trials with a number of samples, a request for 200 notebooks of two sizes, small and medium was forwarded [redacted] By April 1945 this semi-production trial lot had been delivered to OSS and had received their approval and acceptance (see MRL Reports No. 188 of March 27, 1945, and No. 188A of June 8, 1945). While this order was being filled, [redacted] completed his part of the problem by the development of a briefcase size unit which was successfully demonstrated in March. Full specifications were given to OSS, and they instituted procurement of fifty of these in April.

Technical Information

1. **Messenger Pouch Destroyer.**

Two designs of this unit were submitted. Design A consists of two identical top sections of the Pocket Incendiary case filled with an [redacted] (b)(3) NatSecAct

[redacted] This unit, placed inside the message pouch in contact with documents interleaved [redacted] (b)(3) NatSecAct, is initiated by pulling the ring of the fuse lighter. Following a delay of 5 sec., the [redacted] (b)(3) NatSecAct mixture burns briskly for about 45 sec. The conflagration of the pouch proceeds vigorously for about 2 min., and as it begins to die down a violent explosion occurs scattering all traces of the original unit and the charred documents.

[redacted] (b)(3) NatSecAct

2. **Incendiary Moth.**

[redacted] (b)(3) NatSecAct

3. Explosive Moth.

[redacted] (b)(3) NatSecAct

Problem Submitted: July 14, 1944. **Problem Terminated:** June 30, 19[redacted] (b)(3) CIAAct (b)(3) NatSecAct (b)(6)

Contract: OEMsr-1214 with [redacted] (b)(3) CIAAct (b)(6) [redacted] official investigators; November 15, 1943, to May 31, 1945.

OEMsr-955 with [redacted] official investigator. (b)(3) CIAAct (b)(3) NatSecAct (b)(6)

Final Reports: Messenger Pouch Destroyer: Division 19 Serial No. 30, Part I, dated December 21, 1943, forwarded to [redacted] on May 30, 1945. (b)(3) CIAAct (b)(6)

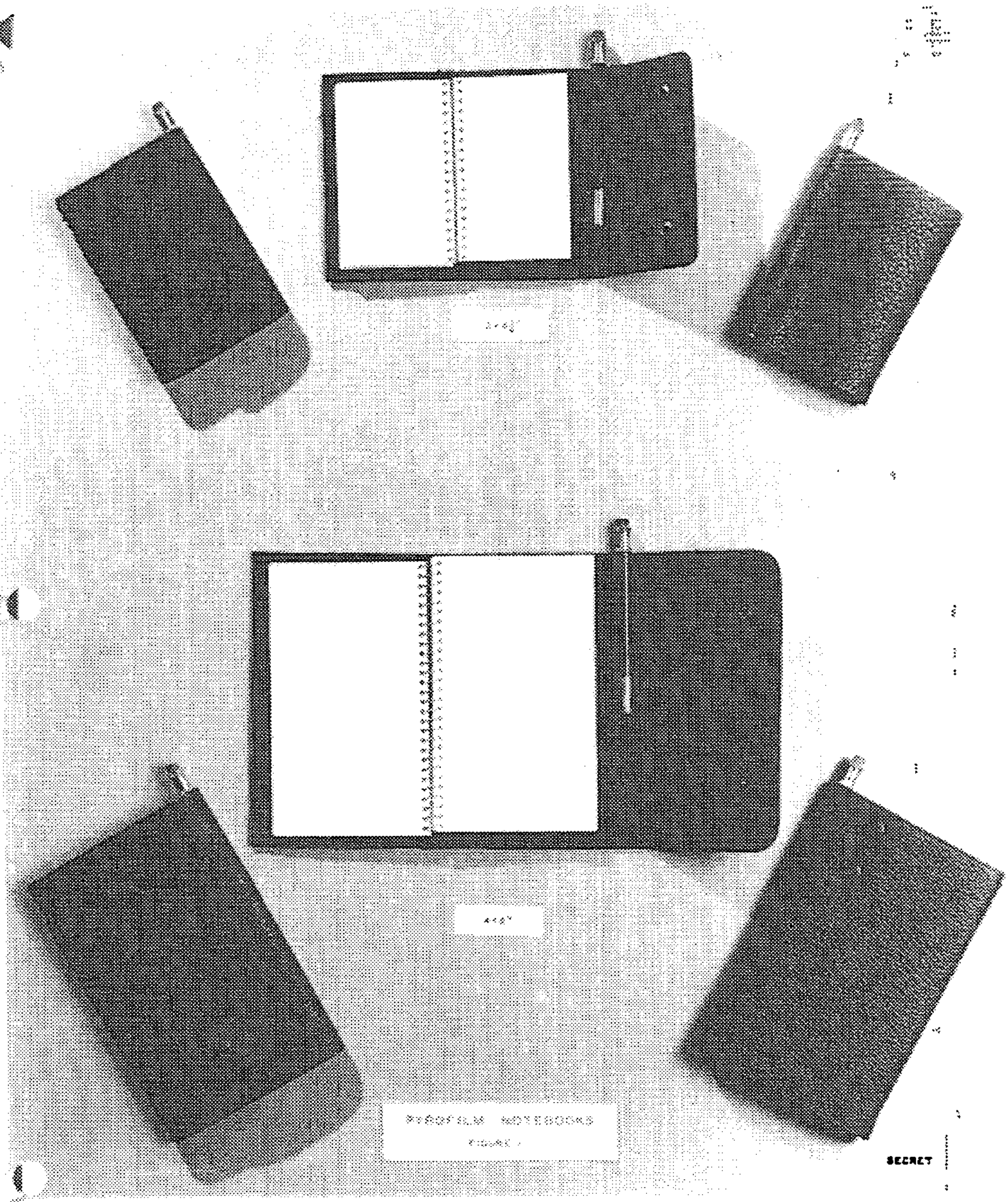
Incendiary Moth: Division 19 Serial No. 30, Part III, dated April 19, 1945, forwarded to [redacted] on May 28, 1945.

Explosive Moth: MRL Report No. 173, dated January 22, 1945, and MRL Report No. 202, dated May 4, 1945.

Patent Reports: Forwarded to Captain [redacted] on June 2, 1945, from [redacted] (1) Moth, and (2) Pyrofilm and Its Application. (b)(3) NatSecAct (b)(3) CIAAct (b)(6)

Forwarded to Captain [redacted] on April 11, 1945, from [redacted] "Explosive Brief Case Destroyer" by (b)(3) CIAAct (b)(6)

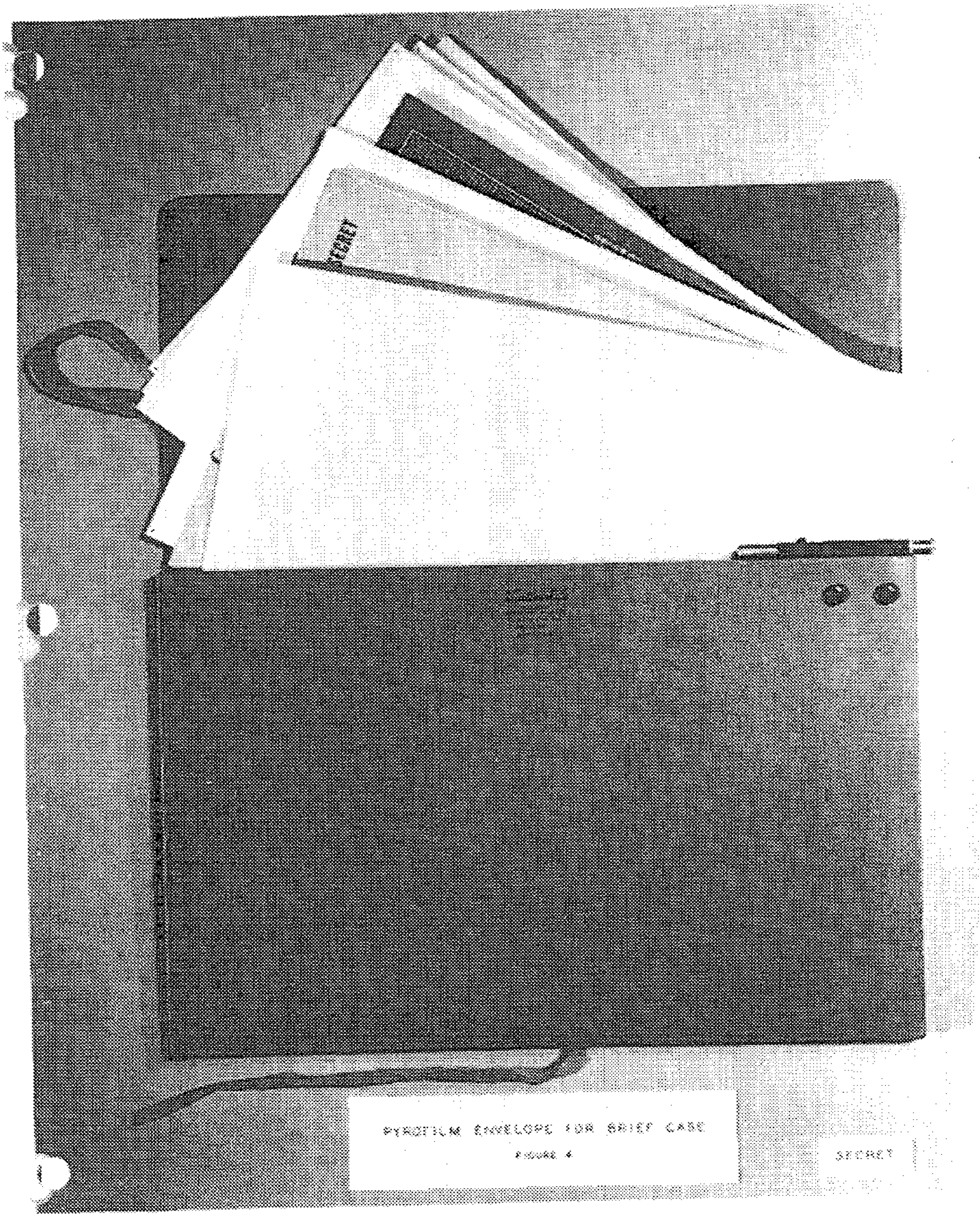
(b)(3) CIAAct (b)(3) NatSecAct (b)(6)



SECRET

FIGURE 2

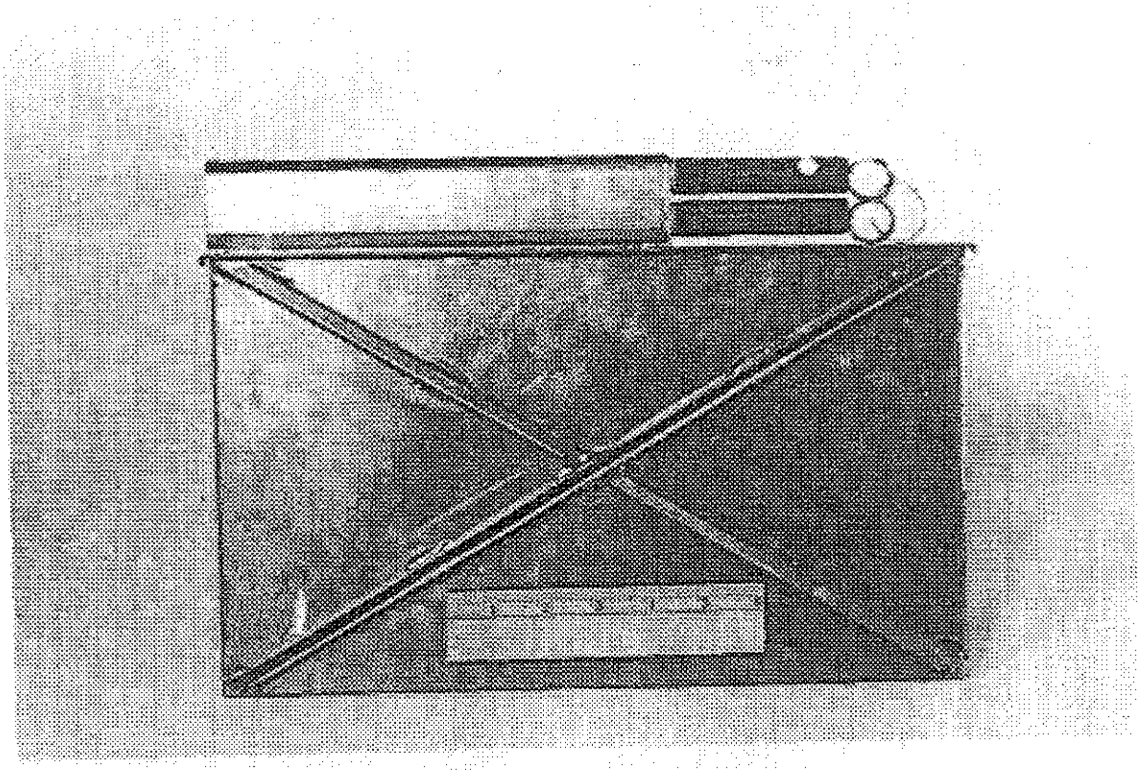
SECRET

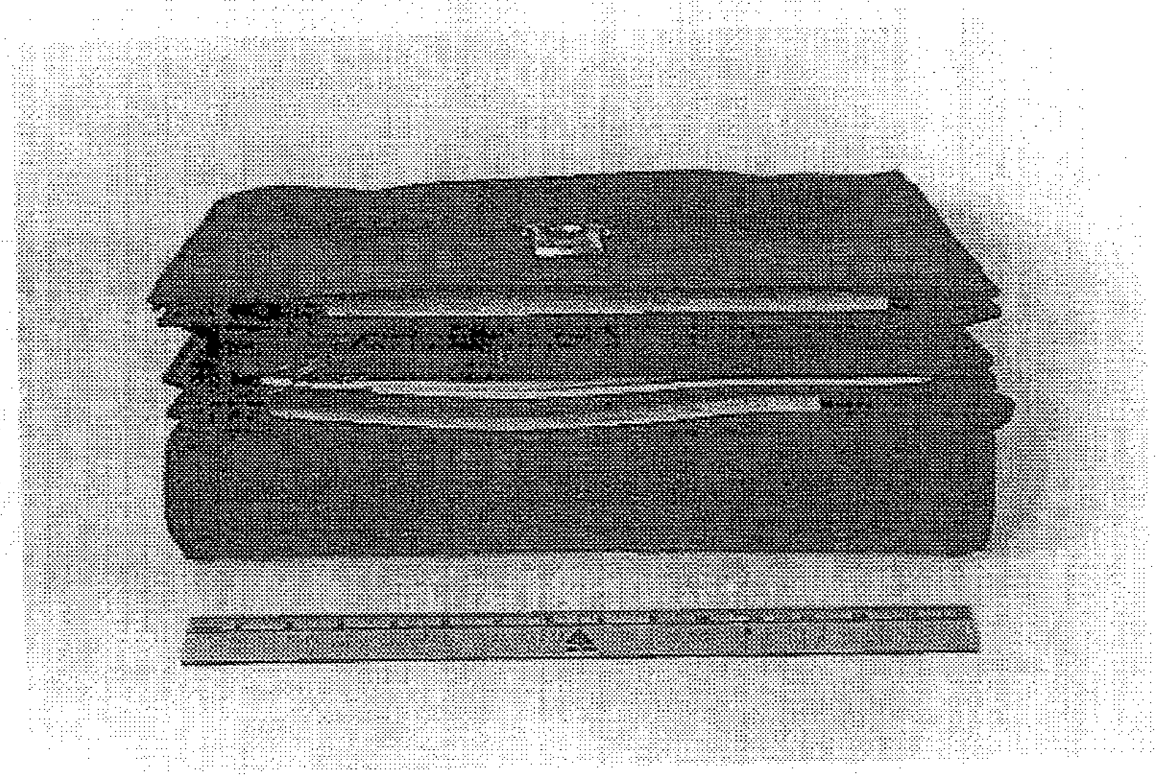


PYROFILM ENVELOPE FOR BRIEF CASE

FIGURE 4

SECRET





SAC-48 PACKAGING

Operational Background

The supply branches of the Army and Navy had known for many years the requirements that devices and weapons would have to meet to be delivered to the user in the field in the perfect condition in which they left the original manufacturer. Such great testing centers as Camp Lee, Aberdeen, Proving Ground, Edgewood Arsenal, and Wright Field served the Army in testing and devising packages and equipment to insure its withstanding the extremely rough handling and the adverse exposure to the elements which it would receive.

Since Division 19 in general assumed the responsibility for OSS research and development, it had always been concerned with this problem, and the problem was especially acute because OSS and SOE requirements were in general more severe than those laid down by the regular Services. This arose from the nature of operations where many devices were dropped by air or were smuggled ashore by swimmers and thus required strong and waterproof packages. Moreover, it was frequently the case that stores of weapons would be buried or hidden for many months before eventual use, further aggravating the packaging problem and necessitating the most careful design of equipment prior to its manufacture.

General Statement of the Problem

Although this activity had been going on since the foundation of the central laboratory at MRL, it had never been formalized and each item was treated as an individual case. It was proposed by OSS that more emphasis be placed upon packaging and that MRL increase its testing facility and assist in the selection of the best packages for different devices. In addition, it was desired that a Packaging Committee should function which would review the results of tests and would lay down the agenda for testing of all new devices.

The problem in this form was acceptable to NDRC, although it was carefully pointed out that because of the tremendous amount of work along these lines which the Army and Navy had already done Division 19 should do no more than apply these discoveries and test the results.

Historical Background

For some months before the submission of the problem, MRL had from time to time tested the resistance of specific packaging materials to rough handling and adverse weather conditions (see MRL Report No. 50 of February 18, 1944, on X-Crepe and No. 64 of March 23, 1944, on Metallized Envelopes). [redacted] at the Laboratory had proposed a Test Agenda which was in operation from its inception December 11, 1943. Then, in March 1944, a cooperative arrangement was established between MRL and the Cameron Depot of the Quartermaster Corps. (b)(3) CIAAct (b)(6)

With the receipt of the problem in June, the Test Agenda was thoroughly reviewed and modified, and a list of devices was decided upon by the newly established Packaging Committee as meriting further test. As an added service, Division 19 arranged a contact between OSS, SOE, and established expert groups such as the Navy Container Committee and the NDRC Tropical Deterioration Committee. MRL at the same time secured the cooperation [redacted] and chairman of a committee which had drawn up Army and Navy packaging specifications. The last constructive step taken was the establishment of the final Test Agenda of August 15, 1944. This was distributed to all Division contractors, so that they would be fully informed of the severe treatment that their devices would have to survive at the hands of MRL, acting in their capacity as testing agent for OSS. Even so, the contractors did not always understand the "unreasonable" treatment, although no one denied that as a result much better and more reliable devices were produced. (b)(3) CIAAct (b)(3) NatSecAct (b)(6)

Technical Information

A quotation from the Test Agenda is informative:

"The following procedures should be considered as accelerated acceptance tests and as such will not necessarily present a true picture of the behavior of packaging or devices under actual field conditions. Since the various tests are unusually severe, it may be rightfully assumed that such structural and functional weaknesses which would break down after a comparatively brief time in the field will be exposed by these tests.

"The failure of a device to pass these tests is not certain evidence that it will fail in the field, nor will all devices which pass function successfully under field conditions. However, those devices which pass can be considered excellent risks and those which fail do not deserve further consideration unless the importance of the device or other special reasons make such a course advisable. Devices which pass some but not all of the tests may be accepted for limited issue or may prove entirely satisfactory when certain precautions are observed in their storage or use. Such limitations should be indicated to the users.

"All test results should be analyzed and interpreted carefully, bearing in mind the ultimate use of the device in conjunction with the weaknesses exposed by the tests.

"The various tests to which an item will be subjected shall be clearly specified by the User Trial Committee. This allows the Committee to specify combinations of tests and any desired alterations of tests.

SUMMARY OF TESTS

"A. Unpackaged Stores: Unprotected - As the device is when required to function.

Obligatory		Optional	
U-I	Tropical Conditions	U-IV	Combined Desert and Tropical Conditions
U-II	Arctic Conditions	U-V	Immersion (Obligatory for underwater devices only)
U-III	Desert Conditions	U-VII	Combined Test
U-V	Immersion (Obligatory for underwater devices only)	U-VIII	Vibration Test
U-VI	Rough Handling	U-IX	Accelerated Aging Test
		U-X	Radiation Test

"B. Semi-Packaged Stores: Unit or group protection as packed within bulk or final outer protection for shipping.

Obligatory		Optional	
S-I	Tropical Weathering	S-IV	Corrosion Test
S-II	Arctic Storage	S-V	Burial Test
S-III	Rough Handling		
S-VI	Combined Tests		

"C. Packaged Stores: Bulk packing as shipped.

Obligatory		Optional	
I	Tropical Weathering	IV	Corrosion Test
II	Arctic Storage	V	Burial Test
III	Rough Handling	VI	Combined Test

"Unless otherwise specified, all obligatory tests shall be carried out by the laboratory. It shall be the responsibility of the User Trial Committee to specify any optional tests considered necessary to thoroughly test a device."

The details of these elaborate tests are not given here. It is sufficient to say that in general they were considerably more severe than the standard Army and Navy requirements.

Problem Submitted: June 30, 1944.

Problem Terminated: June 8, 1945.

Contract: OEMsr-955 with [redacted] official investigator.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Final Report: None.

Invention Report: No inventions were made.

Classification: ~~Secret~~

SAC-49 TVA

Operational Background

Late in the spring of 1944 an unparalleled opportunity presented itself to test many of the developed devices and techniques under conditions approximating field use. This arose when it was learned that the Tennessee Valley Authority in the construction of Fontana Dam was to flood a valley in North Carolina. Thus there was available for full-scale destructive experimentation houses, beidges, railroad tracks, and even a railroad tunnel. The value of these targets for operational study needs no amplification.

General Statement of the Problem

On May 30, 1944, a group of OSS officers submitted a report on a visit to Knoxville, Tennessee, and Bryson City, North Carolina. This described in detail the facilities which could be had and suggested that either OSS or OSS and NDRC proceed to acquire these facilities for experimentation and test. A number of specific techniques and devices were proposed.

Informal conversations continued until July 13, when OSS requested that NDRC "take charge of andcompletely handle a test program in the TVA with R&D serving as liaison and supplying all available items of standard Army procurement to be used in the test work." OSS agreed also to police the area and to provide sufficient military personnel to conduct the experiments.

Historical Background

Acceptance of this problem by OSRD followed considerable legal work, since negotiations were required between OSRD, TVA, and the Southern Railroad and Division 19's contractor, [redacted] On August 7, (b)(3) NatSecAct 1944, Dr. Conant, on the recommendation of the NDRC Reviewing Committee, recommended to Dr. Bush acceptance of the problem, and this was followed by a visit to the spot by representatives of MRL, Division 19, the OSRD Legal Department, and OSS. The result of this was a decision on the detailed targets which were desired for experimentation and the organization of a group which would handle the considerable program.

The latter was centered in a TVA Committee, of which [redacted] (b)(3) CIAAct (b)(6) of MRL acted as chairman. Included were subcommittees on the following subjects: Casey Jones, Arson, Dust Explosives, and Bridge Demolitions.

At this time OSS agreed to supply a group from their Field Photographic Branch to record the proceedings. The first meeting of this TVA Committee was held on August 16, at which time agenda for the different tests were planned in considerable detail.

On August 19, legal letters were passed, and the tests proceeded smoothly covering the period from August 28, 1945, to August 31. They were attended by a large group numbering nearly seventy-five people which included from NDRC Dr. Roger Adams, [redacted] Division 19 members with the exception of Dr. Klopsteg, and representatives of all the interested contractors. OSS provided a large contingent from the sections on Special Operations, Schools and Training, and Research and Development. No untoward incidents occurred, and it was conclusively shown that the devices and techniques which had been developed and which were tested could be counted upon by OSS to perform favorably in the field. A full length moving picture was prepared by the Field Photographic Branch of OSS and was viewed by NDRC on September 22, 1944.

(b)(3) CIAAct
(b)(6)

Technical Information

The following information is drawn from MRL Report No. 151 entitled "A Summary of the Results Obtained in the Testing Program Held in the TVA Reservoir Area near Bryson City, North Carolina, October 16, 1944." Since all of the devices have already been described under the different problem numbers, it will be sufficient to record here the results only, without including a description of these devices.

1. Mole (SAC-10).

Field trials were carried out on an abandoned spur of the Southern Railroad running along the valley of the Little Tennessee River about 15 miles below Bryson City. This property included a single-track railroad tunnel 621 ft. in length. A number of trials were made in which Moles were fastened to empty box cars and were pushed into this tunnel by locomotives at speeds up to 20 mph. These trials indicated the Mole to have good roadability and consistent firing performance. No Mole failed to fire when plunged into the darkness of the tunnel; however, one Mole did fire in the semi-darkness of a cut prior to reaching the tunnel, and another Mole fired prematurely, apparently due to mishandling.

A wrecking trial was also run in the tunnel to estimate the extent of interruption of railroad track by the wrecking of a train of laden freight cars. This train consisted of four gondolas loaded with sand and two empty box cars. It was given an initial momentum by a locomotive and then allowed to coast into the tunnel at a speed of about 15 mph. The brakes were put out of action by draining air from the reservoirs on the train; also, one rail very near to the exit portal was unspiked to prevent the train from overrunning the tunnel. An explosive

(b)(3) NatSecAct

charge [redacted] was loaded on a truck side of the first gondola and initiated with a Mole. This fired at 7 sec. after entering the tunnel, causing the explosion to occur 150 ft. from the entrance portal. In spite of apparent derailment of the front end of the leading car, inertia of the train carried it some 300 ft. to the bent rail, where it was effectively derailed and stopped. It was estimated that with first-class railway facilities and personnel the wreckage could be cleared and traffic resumed in about 12 hrs.

2. Odometer (SAC-10).

Just short of the tunnel was a trestle of about 200 ft. in length. This provided an excellent target for the testing of the Odometer. When this device was affixed to a Southern Railway flat car and set for distances measured against a railway profile map, it was found to fire accurately within 1/100 of a mile in 418 miles. It was concluded that if a trestle longer than 50 ft. were provided an operator 100 miles away who knew the track distance with that accuracy could accomplish a wreck in a vulnerable spot.

3. Fountain (SAC-10).

No explosive tests were run with this device, but moving pictures were taken to complete the comprehensive pictorial presentation prepared by OSS Field Photographic.

4. Railway Cutting - BRP (SAC-10).

Following completion of the Camp Claiborne tests, the question arose whether the technique evolved for BRP was satisfactory for roadbeds having different types of ballast and different weights of rail. The spur line of the Southern Railway at TVA gave the opportunity to settle these points. A section of a single railroad track 2300 ft. long was provided with rails of various weights (130 lbs., 110 lbs., 100 lbs., and 80 lbs./ yd.). It was also ballasted in different ways using cinders, gravel, and crushed rock, and a number of tests were made with the result that the double charge method recommended at Camp Claiborne was replaced for OSS use by a triple charge method. These tests were long and arduous and required a second visit to the area by the Casey Jones Subcommittee a month after the regular TVA tests.

On the basis of the results obtained, the following method was recommended by OSS to their operators:

(b)(3) NatSecAct

[redacted] No satisfactory, practical method can be recommended for rail bending.

"The result of this placement of charge is essentially the same regardless of ballast or rail weight and produces a crater some 6 ft. in length and close to 20 ins. in depth, while the receiving end of the rail is generally bent upward 1 to 4 ins."

4. Arson. (SAC-6).

A number of old but solid houses and some old furniture were available for full study of the most effective manner to use [redacted] (b)(3) NatSecAct The information obtained was the basis for the subsequent Arson Manual prepared by Dr. L. F. Fieser.

The TVA experiment showed that all the incendiaries tried were effective but that the PI was for its weight and size far and away the most valuable sabotage incendiary device. When properly placed, the PI in several instances produced within 3 min. of its actuation a fire which was uncontrollable with portable fire-fighting equipment. It was found possible to recognize without ambiguity within 5 to 15 sec. the time at which a fire reaches a point of such rapid acceleration, usually with an advancing flame across the ceiling, that it must be extinguished at once or be beyond the control of one or two stirrup pumps. This allowed the use of a given test house for a large number of tests, but in all cases the workers had the satisfaction in the end of burning the house to the ground.

(b)(3) CIAAct

5. Dust Explosions (SAC-31).

Two houses were made available for a thorough test of Lulu and an incomplete test [redacted] The results were most encouraging when Lulu was used with flour. The [redacted] results were not so conclusive. A two-story storage house having a volume of about 30,000 cu. ft. with its windows boarded to minimize venting area was attacked with [redacted] sack of flour containing a standard Lulu (see MRL Report No. 92). The house was completely demolished, the roof being lifted slightly while all four walls were blown outward. Although a large ball of flame surrounded the structure as it collapsed, the wreckage was not ignited. A second trial was made on a two-story frame dwelling of about 10,000-cu.-ft. volume and compartmented into five rooms. When the dust explosion was initiated, the roof was slightly lifted the rear wall was dislodged from the other walls, and window frames were thrown out. While the house did not collapse, it was in such condition that it would not have been safe to use.

(b)(3) NatSecAct
NatSecAct
(b)(3) NatSecAct

6. Candle (SAC-30).

The effectiveness of Candle was demonstrated when two specimens containing steel tubes of thickness 0.063 and 0.049 ins. were fired 2 to 3 ft. above the floor in a 14x14-ft. room. A belt of fragments resulted averaging between 4 and 8 per linear ft.

7. Black Joe (SAC-30).

A 3-lb. block of camouflaged coal was placed on a pile of wood in a fireplace of one of these houses, and a fire was started with a 10-min. delay PI. Two minutes after the PI lighted the fireplace, the Black Joe exploded, lifting the roof and blowing out several windows. An examination showed that the interior partitions were broken down, one exterior wall was shattered, the ceiling was shattered and sagging, the porch was loosened from the house by about 3 in., and the fireplace was damaged.

8. Fog Signals (SAC-10).

These devices used for initiating BRP charges were in OSS procurement at the time. Forty production samples were tested using a 100-ton locomotive provided by the Southern Railway. All of them fired satisfactorily.

Problem Submitted: July 13, 1944. Problem Terminated: September 19, 1944.

Contract: OEMsr-955 with [redacted] official investigator.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Final Report: NRL Report No. 151 dated October 16, 1944.

Patent Report: No inventions were made.

Classification: Confidential

SAC-50 DOG DRAG

Operational Background

SOE agents were provided with a device known as Dog Drag which was to be used in case they were pursued by Gestapo bloodhounds. It consisted of a metal container holding an ampoule of strong-smelling chemicals and a canvas sack which would soak up these chemicals when the ampoule was crushed. This device, dragged by an agent behind him while executing complicated maneuvers to make his trail difficult to follow, was apparently satisfactory in British hands. Full information about it was supplied to OSS by SOE in January 1943, and approximately a year later OSS was in procurement of 400 units to be used jointly by the two organizations.

When the first part of these units was available in July, OSS arranged for their field test using dogs of the Quartermaster Corps, who were said to have similar interest, since a device of this kind would be valuable to paratroopers and aviators. Unfortunately, the tests failed completely, the dogs not being baffled at all. OSS thereupon submitted the problem to Division 19.

General Statement of the Problem

NDRC was requested to proceed with the "development of a suitable means of preventing dogs from following a man."

Historical Background

(b)(3) NatSecAct

One of the country's experts on odors, [redacted], was connected with [redacted], who had already performed many services for Division 19 under Contract OEMsr-1023. [redacted] was asked at once to analyze the problem and to submit his suggestions. The ampoule in the British Dog Drag was filled with a mixture of equal parts of caproic, i-valeric acids and castor oil. [redacted] suggested that it might be improved by the use of acids of lower volatility, such as phenylacetic or n-caprylic, or by constituents of an increased footy odor, such as indole. He agreed to prepare a number of mixtures and to submit them to test.

(b)(3) CIAAct (b)(6)
(b)(3) CIAAct (b)(6)
(b)(3) CIAAct (b)(6)

The first of these tests was held at Front Royal, Virginia, on August 25 and 26, 1944, with the cooperation of the War Dog Reception and Training Center. Eight different ideas were tried as follows: (1) chemicals paralyzing the sense of smell; (2) pain causing chemicals; (3) nose tiring chemicals; (4) chemicals arousing fear; (5) chemicals arousing emotions

other than fear; (6) distracting odors of other animals; (7) unpleasant or repulsive odors; and (8) pleasurable odors. The test failed completely. In no case was one of the expert dogs deceived or confused by chemicals intended to represent the above categories. It was noticed, however, that the dogs were more easily misled when the trail was laid on bare ground, and this suggested that perhaps the odor of crushed vegetation might be responsible for the dogs' success. Accordingly, a new trial was held in which grass extract, preserved with 20% alcohol, was tried. At the same time the use of odorless overshoes consisting of Kraft paper bags was tested. A few additional chemicals were at the same time included. These tests took place at Front Royal on October 13 and 14 with dogs that were not so highly trained. It was concluded that a man's scent is not obscured by any of these chemicals and that grass juice had no special virtue. It did appear though that the protecting overshoes were of real value and that some of the chemicals which had been tried were at least equal to those in the British formula.

These observations were fully confirmed in a final trial held November 20 using two very good dogs at the Kanawha State Forest, Charleston, W. Va. On the basis of this it was recommended that the British formula be retained, that very careful adherence to the British operational instructions be given, and that paper bags as foot covers be used. It was thought also that a variety of fillings for the Dog Drag ampoules would be desirable and the chemicals which appeared most promising included α-ionone, trimethyl cyclohexanol, and terpene oil. A British report of November 24, 1944, confirmed these findings, and in the following June the British accepted the foot coverage suggestion and incorporated it in their field instructions.

Technical Information

There are three principal means for covering one's tracks in attempts to baffle dogs: trails that confuse, the use of Dog Drag, and foot coverage. No one of these is usually sufficient alone, but if several are taken in succession one can frequently foil the dog and his handler. It is well to remember, however, that given time enough and no excitement a good dog-and-man team can run down nearly any trail even with several precautions taken. In any event, the use of these hindrances will delay the search, and in conjunction with other factors will frequently cause it to be abandoned.

1. Trails that Confuse.

The very start of the trail should be a matter of the most confusing sort. False starts should be made in several directions, and then finally a path taken not directly to one's objective and more or less downwind. Later one should turn toward the objective making the change of direction on hard ground after some confusing maneuvers. Commonly the Dog Drag should be used in the early part of the trail, especially if it is over rough ground that will take scent well. A

series of three large loops 100 yds. across will distract most dogs, who may not find in all the interlaced trails where the man walks off.

2. Dog Drag.

The British Dog Drag and chemicals are reasonably satisfactory, provided care is taken not to contaminate one's hands, shoes, or clothing when using the Dog Drag. It is suggested that in most cases the Drag trail be started as soon as practical and be continued for at least 500 yards. Just before disposing of the Drag, it is desirable to put on clean foot covering, proceed a few yards further, preferably on a hard surface, and dispose of the Drag.

3. Clean Foot Covering.

Any form of clean, moisture-proof foot covering may be used. After disposal of the Drag, the man should proceed as much as possible over hard surface, preferably starting out in an unexpected direction. The foot coverings may be used until they wear out. If it is desired to remove them because they impede progress, they should be carried at least 500 yards before disposal.

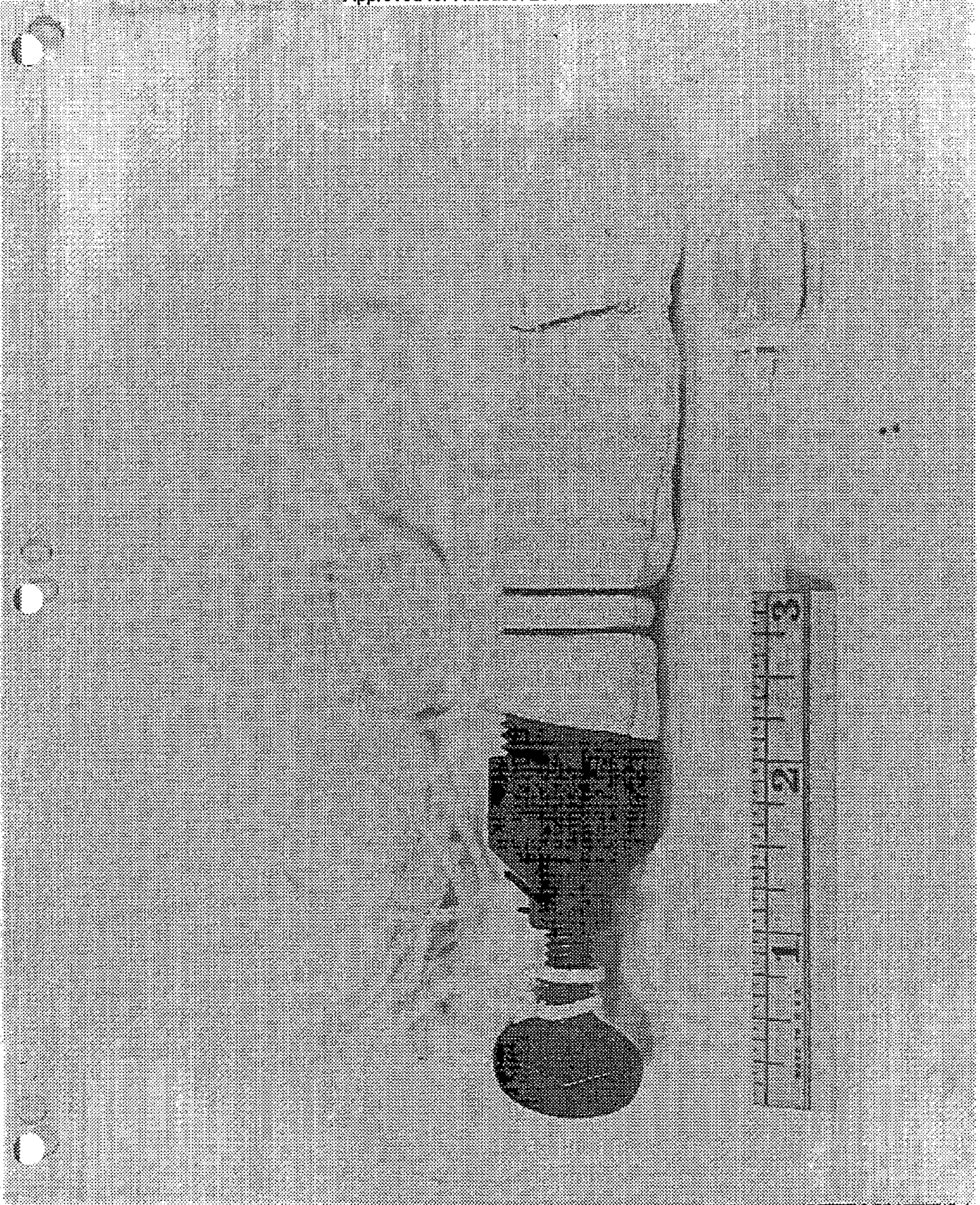
The importance to the man of elapsed time before the dog begins work on his trail is obvious. In practice it is found that 1/2 hour is a minimum time for safe use of these techniques.

Problem Submitted: August 8, 1944. Problem Terminated: March 14, 1945.

Contract: OEMsr-1023 with [redacted] official investigator; May 24, 1943, to June 30, 1945. (b)(3) CIAAct (b)(3) NatSecAct (b)(6)

Final Report: Division 19 Serial No. 22, Part VII, dated April 30, 1945, submitted to [redacted] on October 4, 1945. (b)(3) CIAAct (b)(6)

Patent Report: No inventions were made.



 ~~Secret~~-to-Confidential

SAC-51 AQUA VITA

Operational Background

OSS groups were extremely active in Northern Burma and in China and nearby countries where the resistance of natives was organized against the Japanese. The courageous OSS men who entered this region were separated from their bases for periods of several weeks, during which time they were exposed to the crudest kind of living conditions in disease-ridden jungle country. A source of sterile, inviting water for these men would be a prime item in their effectiveness, health, and morale. They had available to them, of course, the recommended halazon tablets issued by the Surgeon General's Office, but they had no device for converting the turbid river water of that region into a clear, tasteless, and refreshing drinking water. Their representatives in OSS in Washington felt the problem to be an urgent one justifying a development program.

General Statement of the Problem

As first presented, Division 19 was requested to develop a device as follows:

1. A small, portable, light-weight, rugged water purifier (approximate weight 1-1/2 pounds).

2. This device having the ability to produce clear, odorless, tasteless, colorless, bacteriologically sterile, uncontaminated water from such sources as may be encountered in the Far Eastern theater.

3. This device to be produced and tested by the Agency's expert in the field.

Some months later the requirements of the operating groups were made more specific to include in addition a delivery capacity of a quart every three minutes, an acceptable weight of 3 to 5 pounds, a maximum time of use in the field of up to 6 months, and a cost per unit of not more than $100.

Historical Background

Prior to submission of the problem, OSS officers had surveyed the available portable water purifying units. Visits had been made to the Naval Medical Institute at Bethesda, Maryland, Fort Belvoir, the District Engineers, and Edgewood Arsenal. Three outstanding developments emerged as worth consideration:

1. The Quinn Micro-Filter, which by virtue of its ceramic filter of small porosity and a filling of activated charcoal was expected to accomplish the result without added chemical treatment.

2. The Wallace and Tiernan Filter, which made use of a very efficient filter pad but which required chlorination afterward to give sterility.

3. The Bowser Unit, which resembled the Quinn Unit except that it required chemical after-treatment.

Numbers 1 and 3 were hand pumped; Number 2 had a foot pump. OSS decided, on the basis of available information, that the Quinn Unit had the greatest promise, and in August 1944 requested that MRL should duplicate this for OSS test. However, a conference attended by [redacted] (b)(3) CIAAct (b)(6) and representatives of OSS and MRL could not agree on a detailed program, and the more general program quoted above was submitted on September 19, 1944.

(b)(3) CIAAct (b)(6)

(b)(3) CIAAct (b)(6) The early MRL work was under the direction of [redacted] and was limited to a study of mechanical filters based on ceramic and metal filters. It was greatly influenced by the Quinn design, and it was proposed to use active charcoal as recommended by [redacted], (b)(3) CIAAct (b)(6) of Edgewood Arsenal and to accomplish all purification in one step.

(b)(3) CIAAct (b)(6) While this work was underway, Division 19 personnel secured the cooperation of the Committee on Medical Research in any subsequent test program and opened liaison with the Surgeon General's Office, from whom the development [redacted] under CMR contract was first learned.

(b)(3) CIAAct (b)(3) NatSecAct (b)(6) On December 21, 1944, [redacted] then a consultant to the Engineering and Transition Office and previously connected with SAC-27 Anemometer, proposed the use of ozone. He was qualified in the field, having constructed models of field apparatus and having submitted them for Army test. As a result of this new thought, an Aqua Vita Committee was set up which held its first meeting on December 28 attended by [redacted] and MRL and Division 19 representatives. At this meeting the program was outlined to include chemical ozone generation handled by [redacted] at MRL, electro-mechanical ozone generation handled [redacted] and filtration handled [redacted] (b)(3) CIAAct (b)(6)

(b)(3) CIAAct (b)(6)

At the second meeting of the committee on January 10, 1945, [redacted] (b)(3) CIAAct (b)(6) suggested that his part of the program should be handled by an MRL purchase order [redacted] for five units to be made according to designs which he presented. A trip was thereupon made to Dayton, Ohio, by Engineering and Transition Office, MRL, and Division 19 personnel to arrange the details.

(b)(3) NatSecAct

At the third meeting of the committee on January 24, the filtration work was brought to a temporary conclusion by the departure of [redacted]. At that time he had studied the ceramic and powdered silver filters, gross (b)(3) CIAAct (b)(6)

filters of metal screens and fabrics, charcoal absorbents and had designed a unit along the lines of the Bowser device.

The fourth meeting of the committee on February 7 was followed by the abandonment of the electro-mechanical section on February 19 due to legal complications and the unavailability of the proposed contractor. At the same time MRL assumed all responsibility for the entire project, secured the services of [redacted] and installed cultures of E-Coli (b)(3) CIAAct with the concurrence of OSS so that preliminary appraisal could be carried (b)(6) on at the laboratory.

As the work progressed it became more and more apparent that no safe unit depending on filtration alone could be constructed. Any such device would require a post treatment with some kind of chemical. Accordingly, on February 28, 1945 [redacted] was interviewed and his advice was (b)(3) CIAAct obtained on suitable chemicals. It was his suggestion that if C-DC (b)(6) (chlor-dechlor) were allowable this would be the best; if not, then Bursoline No. 3 (triglycine hydrotriiodide) was recommended. He felt that ozone was an unknown quantity and might be uncertain in its action. Dr. [redacted] and his colleague, [redacted] met with MRL, OSS, and Division (b)(3) CIAAct personnel on March 6, when the whole problem was fully explored and Dr. Fa (b)(6) offered to test any developed device under his contract, OEMcmr-251. He suggested the use of Milbank Bags (gravity filters) in conjunction with chemical after-treatment, and [redacted] supplied these for (b)(3) CIAAct MRL test. (b)(6)

In the spring of 1945 the ozone and filtration work dropped to a lower priority and MRL attention was centered on a redesign of the Wallace and Tiernan unit for OSS use. By this time OSS had agreed to a chemical after-treatment and eventually accepted the C-DC procedure in preference to Bursoline, since the latter had not been accepted by the Surgeon General's Office, although many favorable field test results were on file. The Wallace and Tiernan modified model was first shown on June 28, 1945. It was accepted by OSS, who were about to institute procurement when the end of the war intervened.

Technical Information

1. Filter Type Water Purifier.

Using suspensions of carbon particles of known size, a study was made of a variety of ceramic cylinders. These performed very badly, tending to clog and cut down the rate of flow seriously. Greater success was met using 2-in.-diameter porous discs of pure silver formed by the [redacted] These discs performed wit (b)(3) NatSecAct better removal of sediment and less clogging and could be regenerated by back pressure. The observations were made on suspensions of fine clay particles and did not carry over to work with organic slimes and bacteria. The latter very seriously cut down the rate of flow and

prevented regeneration. A certain number of silver discs were found to completely exclude C-Coli. Unfortunately their performance was random and a number of discs which behaved well did not represent more than a small percentage of those actually tested. It appeared that manufacturing problems were insuperable.

With the acceptance of a chemical after-treatment, attention was turned to the Wallace and Tiernan device which utilizes the Seitz K-5 asbestos paper filter pad. This was found to have excellent high retentivity and good resistance to clogging properties, although a great variation from one pad to another existed. It was decided that this pad, in conjunction with a more compact and smaller foot pump would satisfy one man, and accordingly a new design was produced. This has a capacity of about 2 cu. in. per stroke, requiring 30 strokes of water delivered. It is self-priming, the pressure developed depending on the operator's weight, and in lbs./sq.in. is approximately 1/4 of his weight. The optimum pumping weight through a clean pad with clear water is a quart per minute, and the effort is not tiring. The pump has a flat, circular base just under 4 ins. in diameter and requires a reasonably flat and firm supporting surface in operation. The pads are circular, of 3-5/8-in. diameter, and have a 1/4-in. tightly pressed rim. They have an effective filtering area of 8 sq. in. as compared to the 36 sq. in. for the 5-1/2-in. diameter pads of the Wallace and Tiernan unit. The filter pad weighs 6.3 g. or 1 lb., contains 72 pads. The raw water to be filtered and the daily requirements of the men of course will vary widely, but 1 pad per day would probably be a generous estimate if all the drinking water is to be filtered. It is estimated that the pump and filter unit, a 60-day supply of pads, chemicals for water sterilization, and canvas carrying sack would weigh not over 2 lbs. The chemical sterilization is achieved by the standard Wallace and Tiernan C-DC tablets. These depend on an initial superchlorination with halazon followed by a dechlorination to potable limits by sodium bisulfite. Filtration by gravity methods, such as the Milbank Bag, is neither as quick nor as efficient.

2. Ozone Generation by Chemical Methods.

It was hoped that some simple method could be found for generating ozone in the field, and it was estimated that 10 mg/qt. of drinking water would be sufficient to give sterility and remove objectionable taste. The methods tried included cooling of the gases in flames, the slow oxidation of phosphorus by moist air, ultraviolet light, silent electric discharge, stored ozone solutions, electrolysis, and miscellaneous chemical reactions including the interaction of persulfates with acids. None of these methods was found to be satisfactory. In most cases the amount of ozone generated was insufficient or the method was entirely impractical for field adaptation. It was demonstrated, however, that ozone can be formed from the persulfate reaction although in amounts insufficient for the purpose and by methods

impractical in the field. Had the work been of sufficient demand an ozonizer might have been constructed based on the storage battery of a jeep. A laboratory model operated from a 6-volt battery generates sufficient ozone to sterilize 1 liter of water every 5 min. Such a device weighs about 2 lbs.

Problem Submitted: September 19, 1944.

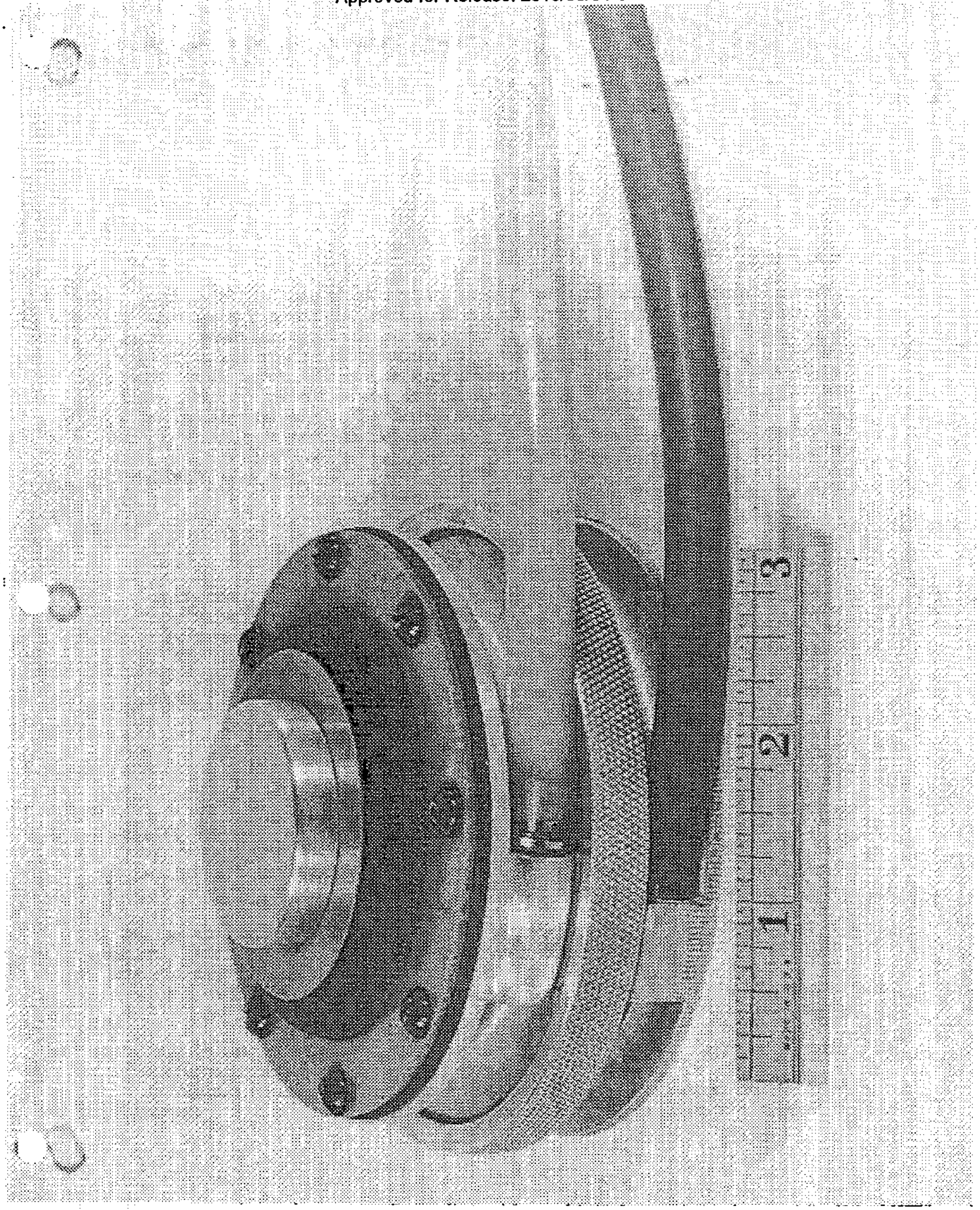
Problem Terminated: June 30, 1945.

Contract: OEMsr-955 with [redacted] (b)(3) CIAAct (b)(3) NatSecAct (b)(6)

(b)(3) CIAAct (b)(6) [redacted] official investigators.

Final Report: MRL Report No. 218 entitled "Small Filter Type Water Purifier" dated August 15, 1945, and Report No. 232 entitled "A Study of Chemical Methods of Producing Small quantities of Ozone" dated August 15, 1945.

Patent Report: No Inventions were made.



Approved for Release: 2018/06/04 C03098524

Classification: ~~Secret to Restricted~~

SAC-52 ZEPHYR

Operational Background

Reconnaissance and Intelligence groups, as they came more and more into activity in the Far East, met the need of silent landing and operation along Japanese held coastlands. In general these activities were carried on by a small number of men who were put ashore from submarines or large surface craft after transfer to canoes, kyak and small boats. The latter were propelled by outboard motors, and it was desirable that these should be as silent in their operation as possible to allow undetected landing and departure. Apparently operations in Europe were not so concerned with this problem, probably because of the superior German detection apparatus and more carefully guarded coast line. The late date at which the problem came to NDRC is thereby accounted for.

General Statement of the Problem

Division 19 was asked to develop kits and instructional booklets which could be used to silence motors already in field use. The problem was therefore not that of designing a silent outboard motor but rather of developing accessories which could be applied in the field to motors already in use. These motors were defined as the 22 H.P. Johnson POIR, the 9.8 H.P. Johnson K, the 9.7 H.P. Evinrude, and the 6 H.P. Mercury.

Historical Background

At the suggestion of the NDRC Chairman's Office, the Engineering and Transition Office was immediately drawn into the picture and [redacted] (b)(3) CIAAct (b)(6) was assigned the responsibility of carrying the program and selecting a contractor. At the same time it was definitely established that neither the Navy nor the Engineer Board had information which bore directly on the problem.

On October 17, 1944, a large meeting of the interested parties was called by Division 19 and the detailed requirements were laid down by the Services. At the same time the preliminary British work on soundproofed housings and exhaust silencing was discussed. It appeared that little information of value had been acquired.

(b)(3) NatSecAct Since both the [redacted] companies were subsidiaries of the [redacted] it was logical to negotiate a contract with that firm, and this began on November 1. Soon thereafter a meeting was held at the [redacted], attend(b)(3) NatSecAct

(b)(3) CIAAct
(b)(6)

among others by [redacted], and OSS representatives. At this time it was decided that the silencing of the 22 POIR would be pushed, it being felt that this was the most difficult of the motors to attack. At the same time Division 19 agreed to supply both SOE and OSS with a number of sample kits for each of the motor types. These were to be for field appraisal and were to enable the Services to decide on further procurement.

(b)(3) CIAAct
(b)(6)

[redacted], with the approval of [redacted] Chief of Division 17, was fortunate in securing the cooperation of [redacted] throughout the active life of the program contributed valuable measurement studies and data analyses. It appeared at once that three sources of sound should receive careful study:

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

(b)(3) CIAAct
(b)(6)

1. Radiant sound of mechanical origin. It was proposed to meet this by the development of a housing or covering later known as a Barney.

2. Exhaust. It was proposed to meet this by a suitably designed muffler.

3. Carburator Intake. It was proposed to meet this by an intake silencer.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Work on all three aspects proceeded simultaneously with the first point covered by a program under the direction [redacted] a consultant to the Engineering and Transition Office. [redacted] had built on the Pacific Coast the first model of a proposed Barney and at the same time supervised the construction by the [redacted] of an experimental plastic housing. The other two points were covered by work done by the [redacted] in conjunction with [redacted]

(b)(3) CIAAct
(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct
(b)(3) NatSecAct

In late December [redacted] visited [redacted] and materially assisted in the guidance of the program by acquainting the group with the latest British experimentation. It was at this time that the plastic housing became available to the [redacted] in Milwaukee, Wisconsin, and was there tested with dubious results.

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct

Two months later the contractor felt that his work had reached a point where a full-scale field trial would be of value in allowing the Service representatives to determine their requirements and to comment on the work already done. This was arranged and took place at Marco Island, near Naples, Florida, February 26 to March 1, 1945. All four motors originally requested were included in this test, together with the Barney and plastic housing developed by [redacted] All the interested parties were present, and the general consensus of opinion can be summed up as follows:

(b)(3) CIAAct
(b)(6)

1. Adequate silencing of the 22 POIR had been obtained by a kit of accessory parts not including a Barney or housing.

2. The 9.8 K motor presented an unsolved problem, not responding to techniques which were successful with the 22.

3. The 9.7 [redacted] required some further work but appeared likely to be solved by the use of a Barney, an exhaust relief, and a carburetor intake silencer.

4. Identical observations may be made about the 6-H.P. Mercury.

5. The plastic housing contributed nothing beyond the Barney, which in itself was not always desirable and accordingly further work on it was suspended.

As a result of this demonstration in which the average reduction of sound varied between 13 and 21 d.b., the Service concluded that a partially satisfactory answer had been obtained and that further silencing would doubtless be possible but at too great an expenditure of time and effort. Accordingly, they accepted the work done as the basis for delivery to them of sample kits and later procurement.

Nevertheless, [redacted] felt that further tests were of value, and after a careful analysis of the sources of sound, he proposed a program which was carried on by the Transition Office from April until September under Contract OEMsr-1375 with [redacted] His work was assisted by [redacted] who had on March 30 replaced [redacted] as the Washington E&TO representative, and by [redacted] of the Pasadena E&TO. He was provided with motors and silencing kits developed under the [redacted] contract and at the same time with a full analysis of underwater noise sources gathered by [redacted] from conversations with the Navy and the Underwater Sound Laboratory at New London, Connecticut. Particularly stressed in [redacted] program was theinsulation of the motor from the boat, the effect of propellor cavitation, noise arising from burbling of the underwater exhaust, and noise radiated from the boat hull. [redacted] work was limited at the start to the 22 H.P. Johnson, but in late May a Navy group at San Diego learned of his experiments and desired that similar work be carried out with the 50 H.P. Johnson used by Navy Rangers on a Chemold plastic boat. This work [redacted] completed in August 1945 (see his report of August 30) with the conclusion that by very simple means a reduction of 14 d.b. could be obtained and that a further reduction of 6 d.b. was possible but expensive.

Throughout the spring and early summer the [redacted] contract was active in the fulfillment of the Division promises of kits to the Services, and these were delivered in July for shipment to the United Kingdom, Australia, and India. A British order for several hundred was immediately forthcoming but the end of the war prevented its completion.

Two other items carried under this problem should be mentioned. On March 12, 1945, OSS requested that work be undertaken on the easy starting of outboard motors, it being stated that in the field operators were sometimes lost because their motors failed to start on the first trial. The question was referred to the manufacturers, together with an analysis of possible design changes which might improve their performance. The companies

appeared rather hurt that their motors should be thus criticized, feeling that if the motor were properly serviced there should be no difficulty. A pamphlet giving detailed instructions for maintenance procedure was distributed on April 28, and at the same time the considerable experience of the Engineer Board in the problem of easy starting was secured for OSS and SOE. After analyzing these documents, OSS concluded that the manufacturer's viewpoint was correct and the request was canceled on May 22, 1945.

The second additional request which came under the heading of Zephyr originated with the Communication Section of OSS when [redacted] (b)(3) CIAAct (b)(6) requested silencing of the 4-H.P., 2-cycle, 1-cylinder engine generator (SSP-8) used by his men for charging batteries in the field. This problem was handled at MRL by [redacted] (b)(3) CIAAct (b)(6) with two motors supplied by OSS. The result was a joint MRL-R&D report of June 7, 1945, which indicated that if the generator were placed in a foxhole thoroughly blanketed and equipped with a simple exhaust muffler satisfactory silencing was obtained.

Technical Information

The various tests showed that a number of factors enter into the noise which an outboard motor gives. These include speed of boat, direction of boat, direction of wind, and ambient noise due to wind and sea. Accordingly, statements regarding the closeness with which a boat can approach the shore without being heard are not always meaningful. An example of the results obtained, however, can be quoted: "The 22 H.P. Johnson approaching the shore at full throttle without silencing is heard at 2250 feet; with silencing, at 1400 feet. The same motor at dead slow speed without silencing is heard at 1840 feet; with silencing, at 280 feet." The latter point is particularly impressive and indicates operational preference for a slow speed.

Careful sound measurements performed by [redacted] (b)(3) CIAAct (b)(6) of the noise level at 25 ft. directly a-stern, for the different motors with and without silencing is as follows: 22 H.P. Johnson unsilenced 95 d.b., with silencing kit 75 d.b., with Barney and kit, 75 d.b.; 9.8 H.P. Johnson unsilenced 79 d.b., with silencing housing, 74 d.b.; 9.7 Evinrude unsilenced 76 d.b., with Barney and kit 63 d.b.; the 6 H.P. Mercury unsilenced 80 d.b., with kit 39 d.b.

A sample of the kits provided is illustrated in this history. It consists of a complete set of all parts necessary to convert a motor already in the field. The chief parts are the exhaust silencer consisting of a tube containing chambers bearing washers equally spaced and similar to rifle silencers. The carburetor intake silencer is of a single chamber resonant type made in the form of a cylindrical can, and the Barney is a cover of acoustic felt tailored to fit the power head of the motor supported over hot spots by a shroud of perforated sheet aluminum and made of glass cloth. It is provided with lashings for attachment. In certain motors an exhaust

relief silencer is included when some of the venting is to the air. Attempt is also made to isolate gas tanks and fuel tanks by rubber insulation. In general such a kit does not interfere seriously with the performance or ease of operation of the motor.

Problem Received: October 5, 1944. Problem Terminated: June 30, 1945.

(b)(3) NatSecAct

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Contract: OEMsr-1427 with [redacted] Company [redacted] Waukegan, Illinois, and [redacted], Milwaukee, Wisconsin, official investigators; October 30, 1944, to July 31, 1945.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

(b)(3) NatSecAct

A contract with the [redacted] a subdivision of [redacted] to cover the cost of the plastic housing was never signed. It was approved by NMC for the period October 30, 1944, to April 30, 1945, in the sum of $7500 and given Symbol No. 5521. It was canceled by [redacted] on May 16, 1945, when the contractor refused to accept the patent clauses of the OSRD form. The cost of the work was absorbed under the [redacted] contract.

(b)(3) CIAAct
(b)(6)

(b)(3) NatSecAct

(b)(3) NatSecAct

Final Report: Division 19 Serial No. 35, [redacted] dated July 18, 1945, and [redacted] Division dated July 30. Submitted to [redacted] on October 29, 1945.

(b)(3) CIAAct
(b)(6)

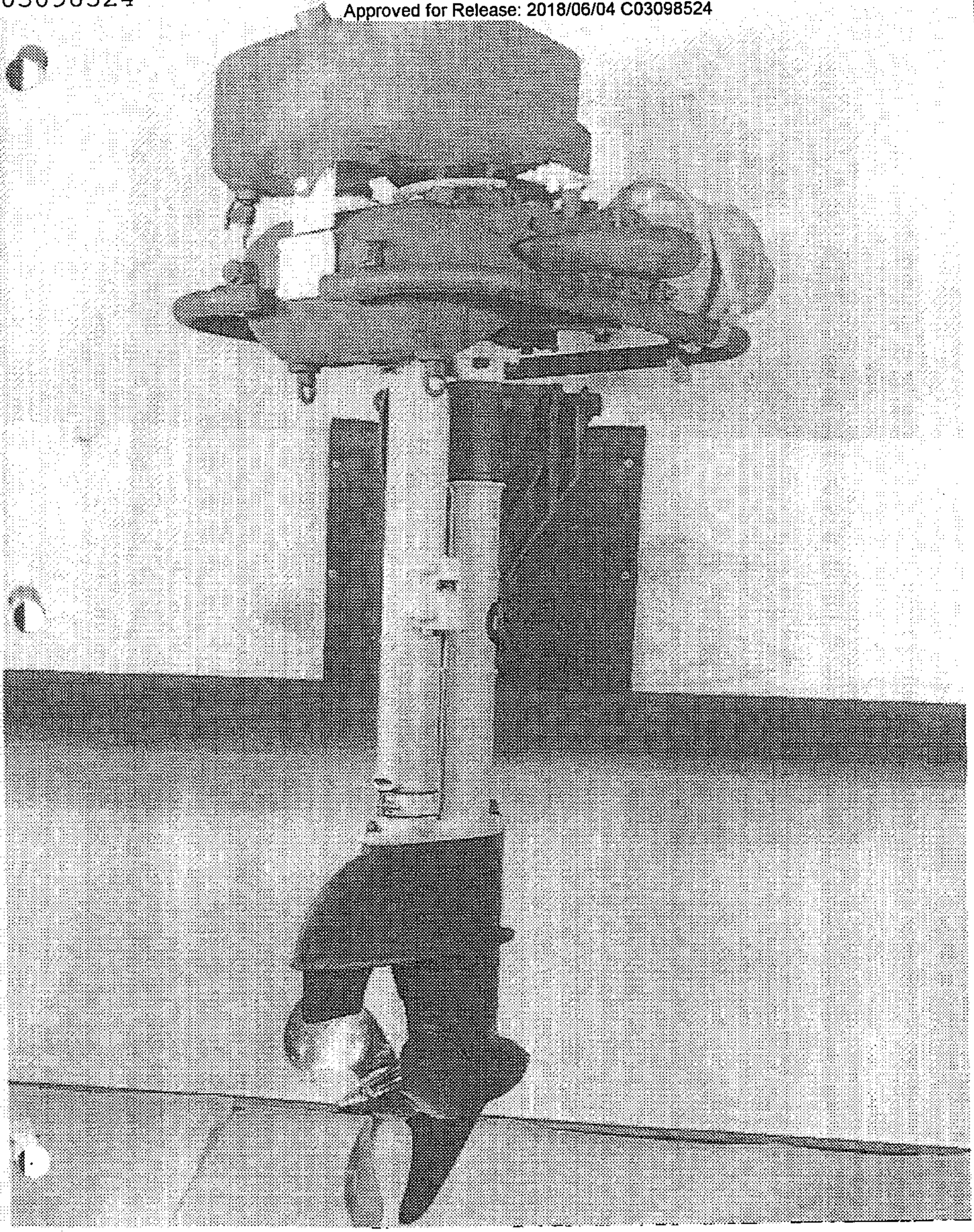
(b)(3) CIAAct
(b)(6)

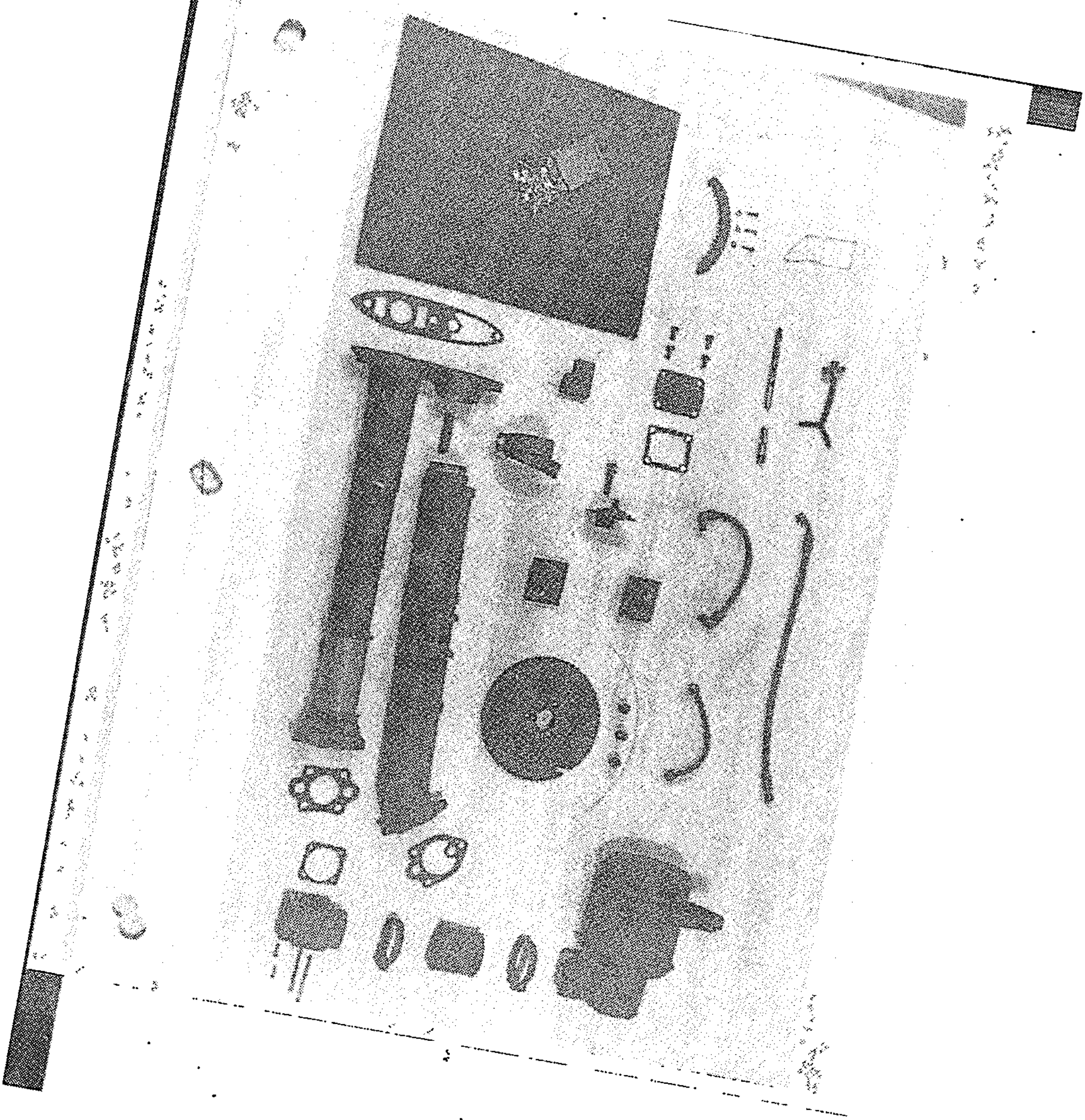
[redacted] work was extremely important and is not reproduced in the final report; it appeared in two reports from [redacted] [redacted] CIR-42, February 6, 1945, "The Silent Engine," and CIR-46, March 12, 1945, "Tests on Silenced Outboard Engines at Naples, Florida." These were combined to form OSRD Report No. 6188 dated November 15, 1945, written under Contract OEMsr-658.

(b)(3) NatSecAct

Patent Report: Forwarded to Captain [redacted] on October 15, 1945; no inventions were made.

(b)(3) CIAAct
(b)(6)





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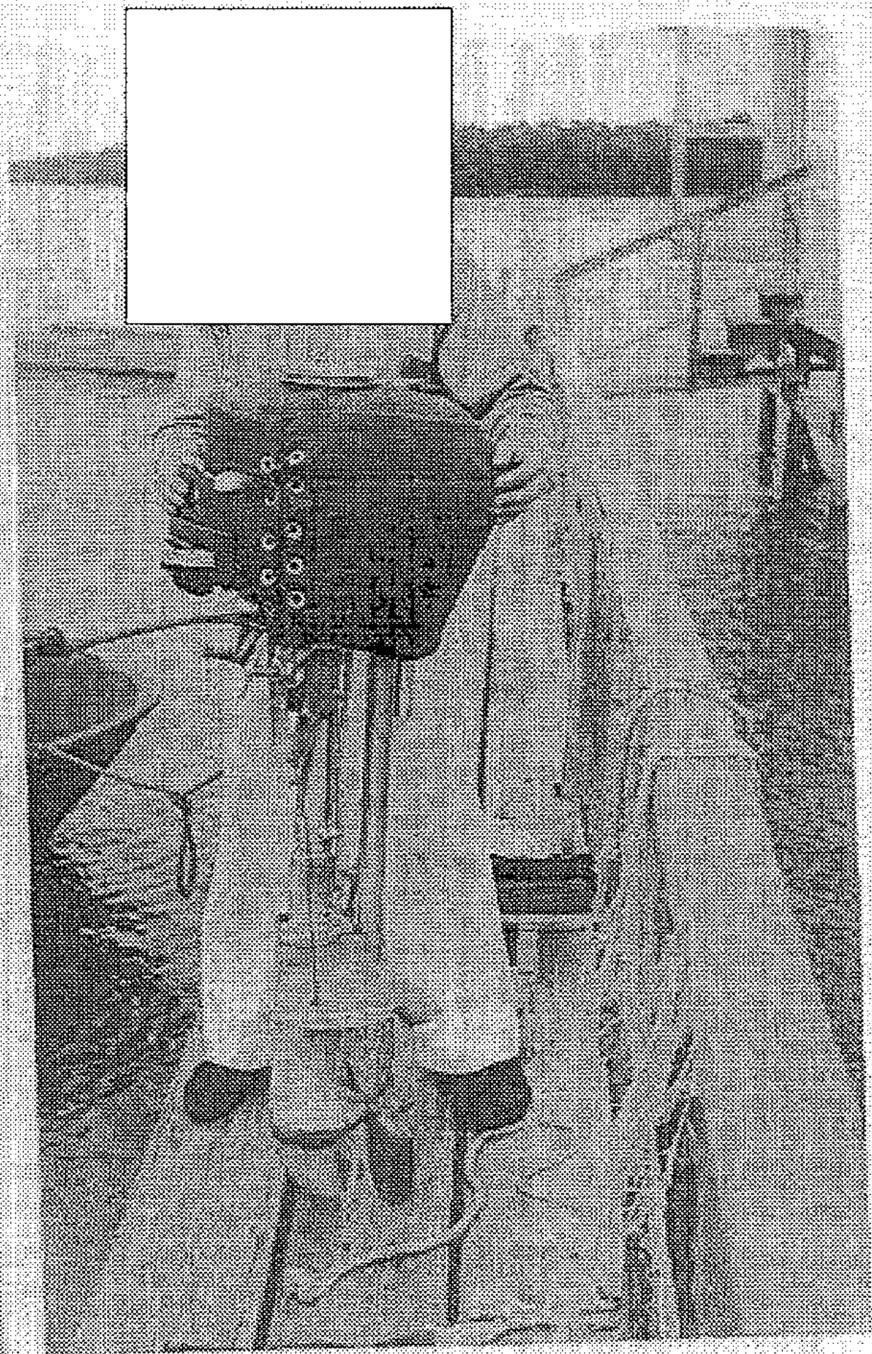
SAC-52

(b)(3) CIAAct
(b)(6)



THE BARNEY

Approved for Release: 2018/06/04 C03098524

MARYLAND RESEARCH LABORATORIES, MRL

Operational Background

During the early days of the Director's Subcommittee, Mr. S. P. Lovell and Mr. Allen Abrams of OSS, Dr. H. M. Chadwell and Dr. W. C. Lothrop of Division 19 visited SOE in England. All were impressed by a research establishment run by ISRB in a country town some 30 miles from London (b)(3) NatSecAct [redacted] Gathered there were a group of research people representing expert knowledge in incendiaries, explosives, camouflage, testing, and mechanical gadgetry. It seemed that the work of the Director's Subcommittee and later Division 19 could profit by the establishment of such a station in this country to function as the central laboratory of the Division and to handle numerous small matters for which OSS had no facilities, and which in themselves did not require the setting up of a separate prime contract by OSRD. The suggestion was discussed with Dr. Bush and met his approval on March 6, 1943.

General Statement of the Problem

The request received from OSS is quoted in full, since it very clearly shows the reasons for the establishment of the central laboratory.

"It is the urgent desire of OSS that a central laboratory be instituted, having as its special function:

"(1) The proving and testing of devices.

"(2) The origination of useful new and miscellaneous weapons especially designed for subversive activity.

"(3) The production, in limited amounts, of camouflaged articles – those to serve as models for larger scale manufacture.

"(4) The correlation and coordination of development of other Services having a significant use in OSS work.

"(5) The maintenance of complete exhibits in pertinent fields as, for example, delay mechanisms.

"The above problem has been the subject matter of conferences for many months. It would seem to fall clearly within the scope of Paragraphs B, C, and E entitled "Creation and Purpose" of the Office of Scientific Research and Development. Obviously for the OSS to initiate or perform

this function, which we all recognize as pressing and worthy would be a misdirection of activity, and intrusion within the field of OSRD.

"It is, therefore, the specific request of this office that such a central laboratory be instituted."

Historical Background

It was decided at the Sandeman Club meeting of March 17 that early arrangements begun by Dr. H. M. Chadwell were appropriate. These included the proposed location of a site for the laboratory close to Washington yet isolated from nearby dwellings. This site, it was hoped, would cover an area somewhere between 10 and 100 acres, would have available water for underwater experiments, a large house for dormitory and laboratory use, and sufficient security for the establishment of incendiary and explosive laboratories.

Upon the advice of the Engineering and Transition Office contact was made with the firm of [redacted] engineers with chief offices located in New York City. A meeting between their representatives and OSRD legal personnel took place on March 29, 1943, and resulted in the writing of a contract.

(b)(3) NatSecAct

At once attempts were made to locate an exact site for the laboratory, and on April 17 it appeared that an estate called Marwood located 12 miles from Washington in Maryland would be suitable. Due to legal difficulties, however, it was not obtained, which was, as events turned out, a fortunate happening, for the Office of Strategic Services shortly thereafter leased the Congressional Country Club for use as a training center. This ideal location, about 10 miles from Washington, had ample surrounding grounds, a large club house, and the necessary seclusion. OSS on April 29 offered OSRD the use of part of the grounds and part of the main building. This was accepted and the legal papers passed in May.

(b)(3) NatSecAct

From the beginning [redacted] assigned to MRL the full time services of [redacted] who functioned most ably as the administrative director from March 30, 1943, until the transference of the laboratory to OSS jurisdiction. As chief Research Director, the Division was very fortunate in securing [redacted] on leave from [redacted] to the OSRD Liaison Office. [redacted] had represented NDRC groups in London for many months, and while there had made the initial contacts with ISRB which eventually resulted, as described in the first part of this history, in the establishment of an SOE Mission in this country. He was therefore entirely familiar with the British arrangements [redacted] with the personnel, with the nature of the problems, and with the British organization set up to service the underground. His first duties on assuming office were to select and hire an adequate scientific staff. This he succeeded in doing with remarkable speed and fortune considering the late date at which the project got underway.

(b)(3) CIAAct
(b)(6)
(b)(3) NatSecAct
(b)(3) NatSecAct

The location of the laboratory was most advantageous, since its proximity to Washington allowed frequent trips by Division 19 personnel and allowed close contact with the regular Services and with OSS, and because of the use of the Club by OSS for training purposes provided a very close contact between the group at the laboratory and Operations.

One wing of the Club house was assigned to [redacted] includin (b)(3) NatSecAct in all an area of 18,400 square feet. In addition, their personnel were provided with living quarters and the opportunity of eating in the officers' mess. An explosives testing area was laid out containing 7 acres of fenced-in woodland, paved roads, and an explosive pit. Also located in this area were an explosives laboratory, magazines, a bomb-proof observation shelter, and a pond equipped for underwater explosions, having a dam with an opening 5 by 4-1/2 feet in its surface. This opening framed with heavy structural steel allowed the attachment of panels for underwater experimentation. In the basement of the Club house was established a testing laboratory with remarkably complete humidity and temperature cabinets, corrosion chambers, vibration tables, and the like. There was in addition a considerable amount of special scientific apparatus, a complete chemistry laboratory, a photographic and camouflage laboratory, and very complete woodwork and instrument shops. The persons who served at the laboratory are too numerous to mention here.

(b)(3) CIAAct
(b)(6)

[redacted] was Technical Director from July 1, 1943, to October 15, 1943, when he resigned to accept work with the Metallurgy Laboratory at the University of Chicago. He was succeeded by [redacted] on leave from the [redacted] left on September 12, 1944, and his place was then taken by [redacted] on leave from the [redacted] remained the Research Director until the dissolution of the laboratory by OSS in August 1945.

(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)
(b)(3) CIAAct
(b)(6)
(b)(3) CIAAct
(b)(6)
(b)(3) CIAAct
(b)(3) NatSecAct
(b)(6)

Efforts of MRL extended over a wide range of activities and cannot be recounted in detail. It is felt that the attached list of over 240 reports will indicate the scope of their work. The bulk of the problems were those of the Office of Strategic Services, although on occasion assistance was given Army and Navy groups.

<u>Special Services.</u>

These ranged from such simple services as furnishing specialized equipment and services to outside groups to performing extensive shop work, or engaging in technical consultation. Demonstrations of weapons and equipment were staged at the request of OSS, Division 19, or SOE. In many cases the planning and performance of these was the responsibility of the MRL staff. At one time a fairly extensive program of specialized technical instruction for OSS personnel was carried out cooperatively by members of MRL and by OSS officers. A number of devices were constructed by the MRL shops to OSS design. In addition, mechanical drawings and illustrative diagrams were prepared as well as still and motion pictures. Practically all the members of the MRL staff acted as consultants from time to time to Division 19 contractors and to OSS procurement.

The Testing Program.

This was both varied and extensive and resulted in determining the functional characteristics of a wide variety of weapons and equipment under rigorous conditions. Over sixty different devices were tested and the efficiency of seventeen packaging materials determined. In the course of this work 26,500 individual items were tested functionally.

Development and Research Work.

This work fell into three general groups: (1) the determination of improved or new methods of use for existing devices; (2) the development of minor improvements in equipment which had been designed elsewhere; (3) the design and development of new devices or processes. The familiarity which the MRL staff attained with OSS problems was a great advantage in saving time and preventing the omission of apparently minor and actually critical factors. As time went on the Research and Development Branch of OSS came to depend more and more upon the laboratory for their final decisions in the matter of adopting and correcting devices. Bi-weekly meetings were held by R&D which were attended by members of MRL and Division 19, as well as SOE liaison officers. In this way the staff of the laboratory was kept entirely up to date with current developments.

As the war progressed it became apparent that MRL would serve OSS better if it were entirely within its jurisdiction. The matter was discussed fully, and a decision was reached at the NDRC meeting of January 12, 1945, when Mr. S. P. Lovell and Mr. C. H. Cheston represented OSS and recommended the transference to their organization of the [redacted] contr(b)(3) NatSecAct
This was formally voted at the NDRC meeting of March 23, 1945, and became effective May 1, 1945.

Establishment: April 1, 1943. Transfer to OSS: April 30, 1945.

Contract: OEMsr-955 with [redacted] (b)(3) CIAAct
administrative representative; March 5, 1943, to April 30, 1945. (b)(3) NatSecAct
(b)(6)

Final Report: Division 19 Serial No. 34 forwarded to [redacted] on (b)(3) CIAAct
August 1, 1945; a progress report was submitted on July 12, 1944. (b)(6)

Patent Report: All inventions were reported to Captain [redacted] on (b)(3) CIAAct
April 11, 1945. (b)(6)

APPENDIX A

LIST OF REPORTS ISSUED BY THE MARYLAND RESEARCH LABORATORIES
(Listed according to Report numbers)

Report No.	Subject	Author	Date of Report
1	Functional Test on Incendiary Pencils, 45° Striker Point.	[redacted] (b)(3) CIAAct (b)(6)	8/21/43
2	Field Trials at Camp Claiborne, Louisiana		9/8/43 to 9/10/43
3	Demonstration Held at MRL 9/16/43		9/16/43
4	Pinning of Limpets by Mines Safety Appliance Method		9/15/43
5	Firing of Clams		9/22/43
6	Plastic Limpets		9/29/43
6A	Plastic Limpets	(Approved by [redacted]) (b)(3) CIAAct (b)(6)	10/1/43
6B	Plastic Limpets	[redacted] (b)(3) CIAAct (b)(6)	11/25/43
7	Pull Tests-Device Firing, A-2 Pull Type	(Approved by [redacted]) (b)(3) CIAAct (b)(6)	10/1/43
8	Stingers. Test for Misfires and Bursting Breech.	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	10/1/43
9	Weight and Dimensional Tests of Firing Device, Release Type	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	10/4/43
10	Demonstration Held at MRL	[redacted]	9/29/43
11	Pressure, Travel and Firing Tests of Push Mechanisms A-1, Type #6	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	10/11/43
12	Initiation of Explosives for Clams	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	10/18/43

Report No.	Subject	Author	Date of Report
13	Immersion Tests on "Jonflex" Tape and "Utilitape"	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	10/29/43
14	Tests of Rubber Bushings and of Strap Construction for Limpets	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	10/30/43
15	Limpetry Trials	[redacted] (b)(3) CIAAct (b)(6)	(a) 10/20/43 (b) 10/20 - 10/22/43 (c) 10/26/43
16	No report issued.		
16A	Report on Field Trials Conducted At Camp Claiborne, La., October 13 to October 15, 1943	[redacted] (b)(3) CIAAct (b)(6)	10/13 - 10/15/43
16B	Report on the Attempted Use of an Early Type of "Anerometer" as Sympathetic Detonator, at Camp Claiborne, La.		10/13 - 10/14/43
16C	Report on Field Trials of "Firefly" Conducted at Camp Claiborne		10/13 - 10/15/43
16D-	Report on Field Trials on "Locomotive" (Casey Jones) Conducted at Camp Claiborne, La.		10/13 - 10/15/43
17	Heat Shrinkage of Threaded Holes in Plastic Limpets	(Approved by [redacted]) (b)(3) CIAAct (b)(6)	11/ 4/43
18	Functional Test of Pencils (SRA-2) Equipped with Copper-Plated Die-Cast End Plugs, Steel Screws, etc.	[redacted]	11/ 8/43
19	Test of Fuse Lighters T-2	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	11/10/43
19A	Test of Fuse Lighter, T-2 (Continued)	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	12/11/43
20	A Test of the Compatability of the Plastic Compound MMAM-EC705 with the Wire, Copper and Solutions of the SRA-2	[redacted] (b)(3) CIAAct (b)(6)	11/13/43
20A	Functional Test of Pencils Sealed with MMAM-EC705		1/14/44

Report No.	Subject	Author	Date of Report	
21	Timing Tests of Pencils Taken from Old Stock (Correction to No. 21 dated 11/22/43)	[redacted]	11/16/43	(b)(3) CIAAct (b)(6)
21A	Timing Tests of Black Pencils Taken from Old Stock	[redacted]	12/14/43	(b)(3) CIAAct (b)(6)
22	Proximate Analysis of "Sealing Plastic Syrup" and "Hardener Solution"	(Approved by [redacted]	11/19/43	(b)(3) CIAAct (b)(6)
23	Tests of Bakelite Adhesive RD-43-86 on Dry and Oily Surfaces	[redacted]	11/18/43	
24	A Partial Statistical Analysis of the Results of Certain Tests of the Timing of Pencils SRA-2		11/26/43 (b)(3) CIAAct (b)(6)	
25	Timing Tests of Standard Production Pencils (Red)		12/14/43	
26	Functional & Weathering Tests on Reconditioned Pocket Incendiaries		12/21/43	
27	Tests on the Large Thermite Well	[redacted]	12/24/43	
28	Weathering Tests of New Type Pocket Incendiaries (Red)	[redacted] (Approved by [redacted]	12/27/43	(b)(3) CIAAct (b)(6)
28A	Weathering Tests of Packaged Pocket Incendiaries	[redacted]	2/ 9/44	
29	Test of Cap Crimpet, T-1		11/10 -12/9/43	
30	Accelerated Aging Tests of the Firefly (SAC-21)		1/ 4/44	
31	Analyses of "Dark" Ampule Solutions and Comparative Timing Tests on Red Pencils Containing "Dark" and "Light" Solutions		1/ 6/44	(b)(3) CIAAct (b)(6)
32	Resistance of Stingers to Tropical Weathering Tests		1/11/44	
33	Lost Chord. Test of Westclock Model		1/15/44	

Report No.	Subject	Author	Date of Report
34	A Proposed Improvement in the Design of the AC Delay Clamping Rings	[redacted]	1/17/44
35	Acceptance Tests of Pocket Incendiaries Equipped with Magnesium Headed Pencils	(b)(3) CIAAct (b)(6)	1/22/44
36	Fog Signals		1/24/44
36A	Test of Fog Signals, 3-A (Correction to Report No. 36A undated)		2/17/44
36B	Test of Fog Signals		3/21/44
36C	Test of Fog Signals	(Approved by [redacted]	5/10/44
37	PEP-2	[redacted]	1/25/44
38	Timing Tests on Firefly Fuzes Subjected to Tropical Conditions	(Approved by [redacted]	1/27/44
39	Analysis of Glycerol Solutions by Means of the Abbe' Refractometer	[redacted]	1/31/44
40	Fountain. Field Test at Aberdeen Proving Ground	(b)(3) CIAAct (b)(6)	1/26/44
41	Release Mechanisms		1/ 4/44
42	Shortstop Vitamin Pills		2/ 1/44
43	Comparison of the Resistance to Weathering of Magnesium & Pyroxoloid Headed Incendiary Pencils		2/ 5/44
44	Test of AC Delays Provided with Clamping Rings Containing Six Slots	[redacted]	2/11/44
45	Comparative Performance Tests of Standard & Modified Pocket Incendiary Fillings	[redacted]	2/11/44
46	Development of a Model of Bushmaster	[redacted]	2/17/44

(b)(3) CIAAct
(b)(6)

(b)(3) CIAAct
(b)(6)

(b)(3) CIAAct
(b)(6)

(b)(3) CIAAct
(b)(6)

Report No.	Subject	Author	Date of Report
47	Beano Throwability of Cylinders Compared to Spheres	[redacted]	2/16/44 (b)(3) CIAAct (b)(6)
48	Demonstration of Silenced Weapons	[redacted] (Reviewed by [redacted]	2/12/44 (b)(3) CIAAct (b)(6)
49	Acceptance Tests for Cotton and Plasticine Submitted by [redacted] (b)(3) NatSecAct	[redacted] (Approved by [redacted]	2/17/44
50	Acceptance Test of Cincinnati Industries, Inc., X-Crepe Bags	[redacted] (Approved by [redacted]	2/18/44 (b)(3) CIAAct (b)(6)
51	Adhesive Cover Paper	[redacted]	2/21/44
52	The Action of Safety Strips in Incendiary Pencils		2/24/44
53	Preliminary Acceptance Tests of Oil Slick Igniters		2/24/44 (b)(3) CIAAct (b)(6)
54	Adhesives		2/19/44
55	Test of Linford's Modified Oxidimetric Method of Glycerol Analysis (Correction to Report 55 dated 3/15/44)		2/23/44
56	Firing Tests of Black Joe	[redacted]	2/26/44
57	Special Acceptance Tests of Primers for SRA's		3/ 4/44 (b)(3) CIAAct (b)(6)
58	Spring Snout Adapters	(Approved by [redacted]	3/ 4/44
59	Development of First Fire for the Thermit Well	[redacted] (Approved by [redacted]	3/ 9/44 (b)(3) CIAAct (b)(6)
60	Clay Objects Made from Aunt Jemima	[redacted] (Reviewed by [redacted]	3/ 8/44 (b)(3) CIAAct (b)(6)
61	Tests of Shaped Charges for Cutting Railroad Car Axles	[redacted] (b)(3) CIAAct (b)(6)	3/15/44
62	Test of Bakelite Adhesive RD-44-12		3/15/44
63	Test for Effectiveness of High Explosives against Wooden Structures	(Approved [redacted]	3/21/44 (b)(3) CIAAct (b)(6)

Report No.	Subject	Author	Date of Report
64	Acceptance Test of Packaging Materials	[redacted] (b)(3) CIAAct (b)(6)	3/23/44
65	Test of Production Beanos		3/30/44
66	A Single Shot Model Bushmaster		4/ 3/44
67	Effect of Tropical Conditions on Certain Batteries		4/ 5/44
68	Life After Activation of a Perchloric Acid Battery N-T-6		4/ 5/44
69	Functional Tests of Pre-Production Fireflies		4/ 6/44
69A	Timing Tests on 50 Fireflies Assembled by the [redacted] (b)(3) NatSecAct		4/21/44
69B	Timing Tests on 10 Fireflies Assembled by the [redacted] Corporation (b)(3) NatSecAct		5/ 1/44
70	Tests of the Resistance of Magnesium Incendiary Heads of SRA's to Tropical Conditions		4/12/44
71	Susceptibility of Factories to Incendiary Sabotage		4/17/44
72	Tests on Safety of Snail and Functioning of Completely Loaded Limpets		3/18 - 3/29/44
73	Functional Tests of the Small Thermit Well & Specific Applications of Large & Small Wells	(Approved by [redacted]) (b)(3) CIAAct (b)(6)	4/19/44
74	Incendiary Capacity of Larger Magnesium Match Heads	[redacted] (b)(3) CIAAct (b)(6)	4/27/44
75	Effect of Orientation and Method of Crushing on the Timings of Red SRA-3's (Correction to Report 75 dated 5/13/44)	[redacted] (b)(3) CIAAct (b)(6)	4/26/44
76	Test of Pencil Primer Sensitivity [redacted] (b)(3) NatSecAct	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	5/ 2/44
77	Evaluation of Aunt Jemima	[redacted]	5/ 2/44

Report No.	Subject	Author	Date of Report
78	Acceptance Tests Applied to Special Beanos Filled with White Phosphorus	[redacted]	5/ 2/44
79	Tests of 10 Anemometers		4/27/44
80	Acceptance Testing of Early Production Clock Work Fuzes	(b)(3) CIAAct (b)(6)	5/ 4/44
80A	Acceptance Test of Modified Production Clockwork Fuzes (Appendix to Report 80A "Tests on Clock Adapters and Adapter Rubber Washers" dated 8/2/44. Author, [redacted] approved by [redacted]	(b)(3) CIAAct (b)(6)	7/10/44
81	Acceptance Tests on "Who, Me?" Tubes	(Approved by [redacted] (b)(3) CIAAct (b)(6)	5/ 5/44
82	Explosive Firewood	[redacted] (Approved by [redacted] (b)(3) CIAAct (b)(6)	5/10/44
83	Fieser Oil Slick Igniters	[redacted] (b)(3) CIAAct (b)(6)	5/10/44
84	Tests of Cap Crimper, T-1 and M-2 Study of Cap and Fuse Joints	(Approved by [redacted]	5/12/44
85	Limpetry	[redacted] (b)(3) CIAAct (b)(6)	5/12/44
86	Acceptance Tests on Modified Oil Igniters Type D2- April 26, 1944	(Approved by [redacted]	5/20/44
87	Functioning of Firefly Fuzes Containing Conical Springs	[redacted] (b)(3) CIAAct (b)(6)	5/22/44
87A	Functioning of Firefly Fuzes Containing Conical Springs		5/31/44
88	Explosive Candle - SAC-30	(Approved by [redacted]	6/ 1/44
89	An Analysis of Glycerol Containing SRA Ampule Solutions with the Aid of the Abbe' Refractometer	[redacted] (b)(3) CIAAct (b)(6)	5/26/44
90	Spigot Gun Demonstration	(Approved by [redacted] (b)(3) CIAAct (b)(6)	5/27/44

Report No.	Subject	Author	Date of Report	
91	Comparison of the Properties of Several Types of Adhesive Tapes	[redacted]	5/27/44	(b)(3) CIAAct (b)(6)
92	Use of Flour and Other Dust Explosives in Attacks on Confined Wooden Structures	(Approved by [redacted]	6/ 6/44	
93	Tests for Effectiveness of High Explosives against Wooden Structures. II.	[redacted] (Approved by [redacted]	6/ 6/44	(b)(3) CIAAct (b)(6)
94	Black Joe - SAC-30	[redacted] (Approved by [redacted]	6/24/44	(b)(3) CIAAct (b)(6)
95	Composition C-3 and Improved PEP-2	[redacted] (Approved by [redacted]	6/16/44	(b)(3) CIAAct (b)(6)
96	Timings of SRA-3's of All Colors at Temperatures Between 0° and 150° F	[redacted]	6/23/44	
97	Behavior of Holmes Sympathetic Fuzes Under Water	[redacted] (Approved by [redacted]	6/12/44	(b)(3) CIAAct (b)(6)
98	Acceptance Tests of Magnesium- Headed SRI's	[redacted]	6/27/44	
99	Development of Initiator for Beano	[redacted] (Approved by [redacted]	7/ 5/44	(b)(3) CIAAct (b)(6)
100	Launching M6A3 Rockets from Their Tubular Cardboard Containers	[redacted]	6/30/44	(b)(3) CIAAct (b)(6)
101	Firing Tests of Fireflys and Modifie[redacted] Charge Cup Fillings	(Approved by [redacted]	6/28/44	
102	Functional Test of British and American Pressure Switches	[redacted]	7/ 4/44	
103	A Reloadable Stinger		7/ 7/44	(b)(3) CIAAct (b)(6)
104	Attempted Development of Short Time Mark I AC Delay by Use of Certain Solvents		7/ 6/44	
105	Humidity, Rough Handling & Waterproofness Tests on Pinning Device	[redacted] (Approved by [redacted]	7/ 7/44	(b)(3) CIAAct (b)(6)
106	Development of A Beano Fuze	[redacted]	7/ 8/44	

Report No.	Subject	Author	Date of Report
107	Special Acceptance Trials of Burroughs Wellcome "Who, Me?" Tubes	[redacted] (Approved by [redacted]	7/ 8/44
108	Functional Tests of U.S. Mk I AC Delays	[redacted]	7/13/44
109	Attempt to Discover a Substitute Superior to Celluloid for Use as AC Delay Discs		7/20/44
110	Behavior of Holmes Sympathetic Fuzes Under Water II	(Approved by [redacted]	7/19/44
111	Veritas	[redacted]	7/24/44
112	Preliminary Experiments on Leak-Compensated Anerometers		7/24/44
113	Bushmaster - Third Report		7/21/44
114	Timings of Green SRA-3's at Temperatures Between 0° & 150° F.		7/28/44
115	Timings of Linford's Modified Green SRA-3's at Temperatures Between 0° & 150° F.		7/29/44
116	Functional Tests of PI's Provided with Clips and Separate Magnesium-Headed SRI's		7/29/44
117	Acceptance Tests of Polyvinyl Chloride Tubes for Use in SRA-3 Packaging		8/ 3/44
118	Acceptance & User Tests of Production Line Firefly Fuzes		8/ 8/44
119	Underwater Pressure Wave from Pin-Ups		8/10/44
120	Effect of Orientation & Method of Crushing on the Timings of Glycerol-Containing SRA-3's		8/12/44
121	Acceptance Tests of Reynolds Metal Foil Bags for Pressure Switches	(Approved by [redacted]	8/15/44
122	Acceptance Trials of American Made AC Delay Celluloid Discs	[redacted]	8/17/44

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Report No.	Subject	Author	Date of Report	
123	Development of Long-Time Delays by the Use of Special Ampules in MK I AC Delays	[redacted]	8/18/44	(b)(3) CIAAct (b)(6)
124	Determination of the Volumes of a Rejected Batch of SRA-3 Ampule Solutions		8/19/44	
125	Camouflage of Lacrima Tojo as Lubricating Oil	[redacted] (Approved by [redacted]	8/24/44	
126	Acceptance Tests on Packaging of Hedy	[redacted] (Approved by [redacted]	8/26/44	(b)(3) CIAAct (b)(6)
127	Acceptance Trial of City Slickers' Containers and Dummy Units (Memo on Report 127 dated 9/6/44)	[redacted] (Approved by [redacted]	8/28/44	(b)(3) CIAAct (b)(6)
128	User Trial of Balsam	[redacted] (Approved by [redacted]	8/29/44	
129	Final Report on Throwing Tests Conducted in Connection with the Development of the Beano	[redacted] (Approved by [redacted]	8/31/44	(b)(3) CIAAct (b)(6)
130	Acceptance Trial Tests of Adhesive AD-44-41	[redacted] (Approved by [redacted]	9/ 2/44	(b)(3) CIAAct (b)(6)
131	Packaging Acceptance Tests of Large and Small Thermit Wells	[redacted] (Approved by [redacted]	9/ 4/44	
132	Acceptance Firing Tests of Fireflys	[redacted] (Approved by [redacted]	9/ 5/44	(b)(3) CIAAct (b)(6)
133	Phosphorescent Target Marking - Evaluation of the Method	[redacted]	9/ 8/44	(b)(3) CIAAct (b)(6)
134	User Trial Tests of "Who, Me?"	(Approved by [redacted]	9/ 7/44	
135	Tests on the Leak-Compensated Anemometer	[redacted]	9/ 9/44	
136	Acceptance Tests of the Mk I Anemometer		9/11/44	(b)(3) CIAAct (b)(6)
137	Battery Contamination		9/14/44	

Report No.	Subject	Author	Date of Report
138	Acceptance and User Trials of Capsules H	[redacted] (Approved by [redacted]	9/16/44
139	Adaptability of Fountain to Mole and Nomo Projects	[redacted]	10/23/44
140	Preliminary Report - Beano Delay Fuze	[redacted]	9/20/44
141	[redacted] Project	[redacted]	9/19/44
142	Simulated Functional Test of the Springs for Perley's Pencil	[redacted] (Approved by [redacted]	9/22/44
143	Acceptance Tests of Caccolube (Supplement to Report 143, Appendix I, dated 10/30/44. Author, [redacted] approved by [redacted]	[redacted]	9/27/44
144	Packaging & Functional Acceptance Tests of Paul Reveres	[redacted] (Approved by [redacted]	10/ 6/44
145	Acceptance Tests of Incendiary Packets	[redacted] (Approved by [redacted]	10/ 9/44
146	Acceptance Tests of TIE2 Detonators	[redacted] (Approved by [redacted]	10/12/44
147	Effect of Firing Pin-Up Guns Into Torpex Loaded Limpets	[redacted]	10/13/44
148	Summary and Final Report on Battery Contamination	[redacted]	10/14/44
149	Odometer Tests in the TVA Area (August 25, 26, 27, and 28, 1944)	[redacted]	9/23/44
150	Acceptance Test of Production Fog Signals (Supplement to Report 150 dated 11/7/44)	[redacted] (Approved by [redacted]	10/20/44
151	A Summary of the Results Obtained in the Testing Program Held in TVA Reservoir Area Near Bryson City, N. C.	[redacted]	10/16/44
152	Dust Explosion Tests in Wooden Houses Located at TVA Reservoir Area Near Bryson City, N. C.	[redacted]	10/16/44

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Report No.	Subject	Author	Date of Report	
153	Analysis of Timing Data of Certain Rejected Batches of SRA-3's	[redacted]	10/26/44	(b)(3) CIAAct (b)(6)
154	Development of a Fuze and an Igniter in Connection with Navy Project NS-164	[redacted]	1/29/45	
155	Preliminary Test on a Silencer for the M1A1 Sub Machine Gun	[redacted]	11/ 2/44	(b)(3) CIAAct (b)(6)
156	Special Acceptance Test of New Fireflys Without Conical Springs	[redacted] (Approved by [redacted])	11/ 2/44	
156A	Functional Testing of Firefly Fuzes from Recent Production Batches	[redacted]	12/ 4/44	(b)(3) CIAAct (b)(6)
157	Confirmatory Acceptance Trial of SRI-Mg	[redacted]	11/ 3/44	(b)(3) CIAAct (b)(6)
158	Acceptance Trial of Preproduction "Who, Me?" Tubes	[redacted] (Approved by [redacted])	11/ 7/44	
159	Acceptance Tests of AC Delay, M-1 "A" Pack	[redacted] (Approved by [redacted])	11/14/44	(b)(3) CIAAct (b)(6)
160	Functional Tests of Mk 35-Mod I Navy Mines	[redacted] (Approved by [redacted])	11/16/44	(b)(3) CIAAct (b)(6)
161	Special Tests of the Firing Pin Springs in Pin-Up Gun	[redacted] (Approved by [redacted])	11/21/44	(b)(3) CIAAct (b)(6)
162	Acceptance Trial Tests on Pin-Up Guns and User Trial Tests on Pin-Up Placing Device	[redacted] (Approved by [redacted])	11/27/44	(b)(3) CIAAct (b)(6)
163	Acceptance Trial of Paul Reveres (Incendiary, Oil Slick, Combination)	[redacted] (Approved by [redacted])	12/11/44	(b)(3) CIAAct (b)(6)
163A	Supplemental Acceptance Tests on Paul Reveres	[redacted] (Approved by [redacted])	1/17/45	(b)(3) CIAAct (b)(6)
164	The Development of a Speedometer	[redacted]	12/ 5/44	(b)(3) CIAAct (b)(6)
165	Tests on Limpet Floats	[redacted] (Approved by [redacted])	12/28/44	(b)(3) CIAAct (b)(6)
166	Functional Tests of the Mk II Anemometer	[redacted] (Approved by [redacted])	12/30/44	(b)(3) CIAAct (b)(6)

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Report No.	Subject	Author	Date of Report	
153	Analysis of Timing Data of Certain Rejected Batches of SRA-3's	[redacted]	10/26/44	(b)(3) CIAAct (b)(6)
154	Development of a Fuze and an Igniter in Connection with Navy Project NS-164	[redacted]	1/29/45	
155	Preliminary Test on a Silencer for the M1A1 Sub Machine Gun	[redacted]	11/ 2/44	(b)(3) CIAAct (b)(6)
156	Special Acceptance Test of New Fireflys Without Conical Springs	[redacted] (Approved by [redacted]	11/ 2/44	
156A	Functional Testing of Firefly Fuzes from Recent Production Batches	[redacted]	12/ 4/44	(b)(3) CIAAct (b)(6)
157	Confirmatory Acceptance Trial of SRI-Mg	[redacted]	11/ 3/44	(b)(3) CIAAct (b)(6)
158	Acceptance Trial of Preproduction "Who, Me?" Tubes	[redacted] (Approved by [redacted]	11/ 7/44	
159	Acceptance Tests of AC Delay, M-1 "A" Pack	[redacted] (Approved by [redacted]	11/14/44	(b)(3) CIAAct (b)(6)
160	Functional Tests of Mk 35-Mod I Navy Mines	[redacted] (Approved by [redacted]	11/16/44	
161	Special Tests of the Firing Pin Springs in Pin-Up Gun	[redacted] (Approved by [redacted]	11/21/44	(b)(3) CIAAct (b)(6)
162	Acceptance Trial Tests on Pin-Up Guns and User Trial Tests on Pin-Up Placing Device	[redacted] (Approved by [redacted]	11/27/44	(b)(3) CIAAct (b)(6)
163	Acceptance Trial of Paul Reveres (Incendiary, Oil Slick, Combination)	[redacted] (Approved by [redacted]	12/11/44	
163A	Supplemental Acceptance Tests on Paul Reveres	[redacted] (Approved by [redacted]	1/17/45	
164	The Development of a Speedometer	[redacted]	12/ 5/44	(b)(3) CIAAct (b)(6)
165	Tests on Limpet Floats	(Approved by [redacted]	12/28/44	
166	Functional Tests of the Mk II Anemometer	[redacted] (Approved by [redacted]	12/30/44	

Report No.	Subject	Author	Date of Report	
167	Studies on SBX. Part II: Comparison of Results Obtained in Part I with Jones' Simplified Theoretical Calculations of SBX Pressure-Time Characteristics (Report 167 Errata and Addenda, dated 2/9/45)	[redacted]	1/ 9/45	(b)(3) CIAAct (b)(6)
168	Test of Pressure Type Anti-personnel Device T4A	[redacted] (Approved by [redacted])	1/ 9/45	(b)(3) CIAAct (b)(6)
169	Functional and Acceptance Testing of Lost Chord	[redacted] (Approved by [redacted])	1/ 9/45	(b)(3) CIAAct (b)(6)
170	Acceptance Tests of Packaged and Unpackaged Sympathetic Fuzes	[redacted] (Approved by [redacted])	1/17/45	(b)(3) CIAAct (b)(6)
171	Breaking Tests on Lanyard for Pin-Up Gun	[redacted] (Approved by [redacted])	1/18/45	(b)(3) CIAAct (b)(6)
171A	Breaking Tests on Lanyard for Pin-Up Gun	[redacted] (Approved by [redacted])	3/10/45	(b)(3) CIAAct (b)(6)
172	Prolonged Tropical Stroage of Unpackaged & PVC Packaged Pencils	[redacted] (Approved by [redacted])	1/18/45	(b)(3) CIAAct (b)(6)
173	Moth-Explosive Briefcase Destroyer	[redacted]	1/22/45	
174	Test of Hand Grenade, Mk IIA1 and Fuzes M10A3, for Sympathetic Detonation		1/26/45	(b)(3) CIAAct
175	Tests on Limpet Floats	[redacted] (Approved by [redacted])	2/ 2/45	(b)(3) CIAAct (b)(6)
176	Supplemental Acceptance Test of Reconditioned PI's	[redacted] (Approved by [redacted])	2/ 2/45	(b)(3) CIAAct (b)(6)
177	Rough Handling of Mk II Anerometers	[redacted] (Approved by [redacted])	2/ 5/45	(b)(3) CIAAct (b)(6)
178	Testing of Magnesium Dust Incendiaries as Developed by [redacted] of England	[redacted]	1/31/45	(b)(3) CIAAct (b)(6)
179	Acceptance Test of Simulator, Rifle Fire (Single Shot Bushmaster)	(Approved by [redacted])	2/ 6/45	
180	Acceptance Test and User Trials of Production Lulus	[redacted]	1/20/45	(b)(3) CIAAct (b)(6)

Report No.	Subject	Author	Date of Report	
181	Effect of Weathering on Dimensions of Limpet Cases	[redacted] (Approved by [redacted]	2/10/45	(b)(3) CIAAct (b)(6)
182	Acceptance Testing of Limpet Guns "W"	[redacted] (Approved by [redacted]	2/10/45	(b)(3) CIAAct (b)(6)
183	Use of Dust and Liquid Slow Burning Explosives in Attacks on Confined Structures	[redacted]	2/ /45	(b)(3) CIAAct (b)(6)
184	The Magnesium-Headed Incendiary Pencil as a Separate Incendiary Igniter	[redacted]	2/19/45	(b)(3) CIAAct (b)(6)
185	Comparison of Original and Modified Anerometer Firing Springs	(Approved by [redacted]	3/14/45	
186	Adaptation of the Mk I AC Delay for Short Timings	[redacted]	3/19/45	(b)(3) CIAAct (b)(6)
187	Acceptance Trial of Packaged AC Delays, Mission Pack	(Approved by [redacted]	3/26/45	
188	Container, Self-Destroying, Medium Size, Incendiary Pocket Notebook Type	[redacted] (Approved by [redacted]	3/27/45	(b)(3) CIAAct (b)(6)
188A	Container, Self-Destroying, Medium Size, Incendiary Pocket Notebook Type. Appendix: Tests on Semi-Packaged Units	[redacted] (Approved by [redacted]	4/8/45	(b)(3) CIAAct (b)(6)
189	Acceptance Test of Production Salt Plugs (67-7) for Use with Sympathetic Fuzes (CD's). (Addendum to Report 189 dated 4/10/45) (Supplement to Report 189 dated 6/23/45. Author, [redacted] approved by [redacted]	[redacted] (Approved by [redacted]	3/27/45	(b)(3) CIAAct (b)(6) (b)(3) CIAAct (b)(6) (b)(3) CIAAct
190	Static Initiation of AN-M50A2 and AN-M69 Incendiary Bombs	[redacted]	3/30/45	(b)(3) CIAAct (b)(6) (b)(3) CIAAct (b)(6)
191	Acceptance Test of Grenade, Gas Tank, Large	(Approved by [redacted]	4/ 5/45	
192	Acceptance Tests of Firing Device, Automatic Weapons, Delay Type	[redacted] (Approved by [redacted]	4/ 9/45	(b)(3) CIAAct (b)(6)

Report No.	Subject	Author	Date of Report	
193	Special User Trial of Firing Device, Clockwork (24 Hours)	[redacted] (Approved by [redacted]	4/ 9/45	(b)(3) CIAAct (b)(6)
194	Acceptance Tests of Firing Device, Automatic Weapons, Pull Type	[redacted] (Approved by [redacted]	4/ 1/45	(b)(3) CIAAct (b)(6)
195	Identification by Chemical Analysis of a Sample of [redacted] (b)(3) NatSecAct	[redacted] (Approved by [redacted]	4/16/45	(b)(3) CIAAct (b)(6)
196	Development of a Ground Mounted Anti-Disturbance Alarm, Trip String Type	[redacted]	4/17/45	
197	Acceptance Trial of Simulator, Rifle Fire	(Approved by [redacted]	4/19/45	(b)(3) CIAAct (b)(6)
198	Packaging Acceptance of Clockwork (12 hours)	[redacted] (Approved by [redacted]	4/25/45	(b)(3) CIAAct (b)(6)
199	Railroad Tests of the Speedometer (April 20, 1945)	[redacted]	4/27/45	(b)(3) CIAAct (b)(6)
200	Acceptance Test of Paper, Soluble	(Approved by [redacted]	5/ 1/45	(b)(3) CIAAct (b)(6)
201	Loading of Spigot Bomb Heads	[redacted]	5/ 1/45	
202	Moth - Explosive Message Carrying Containers Small and Intermediate Size		5/ 4/45	
203	User Trials of the Electrolytic Time Pencil		5/ 4/45	(b)(3) CIAAct (b)(6)
204	Special Test of Packaged Safety Fuze	(Approved by [redacted]	5/ 8/45	
205	The preparation of Short Time AC Delays for Training Purposes	[redacted]	5/11/45	(b)(3) CIAAct (b)(6)
206	Development of Pressure Type Anti-Personnel Device T4A	(Approved by [redacted]	5/15/45	
207	Acceptance Tests on Ampules, AC Delay, Long Time	[redacted] (Approved by [redacted]	5/16/45	(b)(3) CIAAct (b)(6)
208	Apparatus Which Simulates the Effect of a Parachute Drop on Airborne Supplies	[redacted]	5/25/45	(b)(3) CIAAct (b)(6)
209	Special Surveillance Tests of Old Stores of SRA's	[redacted]	5/28/45	

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Report No.	Subject	Author	Date of Report
210	Grenades, Gas Tank, Large	[redacted] (b)(3) CIAAct (b)(6)	5/29/45
211	Acceptance Tests of Firing Device, Clockwork, 24-Hour	(Approved by [redacted])	5/30/45
212	Test of Resistance of AC Delays to Temporary Deep Immersion	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	6/ 1/45
213	Firefly Solvents	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	6/ 2/45
214	Parachute Locator, Bell & Light Type	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	6/ 5/45
215	Manual of Homemade Explosives, Incendiaries and Delays	[redacted]	6/ 9/45
216	Development of Readily Improvised Delays and Incendiaries	[redacted]	7/ 1/45
217	Flash Powder Beano	[redacted] (b)(3) CIAAct (b)(6)	6/21/45
218	Dash-Pot Delayed Arming Device (Silicone)	[redacted]	6/28/45
219	A Small Filter-Type Water Purifier	[redacted] (b)(3) CIAAct (b)(6)	8/13/45
220	Waterproofing of Spigot Gun Cartridges	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	7/ 2/45
221	Wooden Limpet Floats	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	7/ 4/45
222	An Anti-Disturbance Fuse	[redacted]	7/ 4/45
223	Special Detonating Cords - Thirteen Strand Primacord Plastic Explosive Detonating Cord	[redacted]	7/ 9/45
224	A Time Fuse for the Beano Grenade	[redacted]	7/12/45
225	Throwing Tests on Inert Beanos Loaded to 12, 14, 16, and 18 Ounces	[redacted] (b)(3) CIAAct (b)(6)	7/12/45
226	No report issued.		
227	No report issued.		
228	Studies of Variations of the Time Pencil, SRA	[redacted] (Approved by [redacted]) (b)(3) CIAAct (b)(6)	7/16/45

Report No.	Subject	Author	Date of Report	
229	No report issued.			
230	An Electrolytic Delayed Arming Device	[redacted]	7/26/45	(b)(3) CIAAct (b)(6)
231	A Sympathetic Fuze for Air Operation		7/27/45	
232	Study of Chemical Methods of Producing Small Quantities of Ozone	[redacted]	8/15/45	(b)(3) CIAAct (b)(6)
233	User Trial of Mine, Anti-Disturbance		8/ 6/45	
234	Demolitions Equipment Electrical Field Demolitions Kit	[redacted]	8/ 9/45	(b)(3) CIAAct (b)(6)
235	Final Report on Project No. 269 - Reducing the Effect Turbulence on the Arming Time of Marine-Type Sympathetic Fuzes		8/10/45	
236	Final Report on Project No. 265 - Device for Multiple Firing of Pin-Up Guns		8/17/45	
237	Gas Tank Grenade, Small Improved Type	[redacted]	8/20/45	(b)(3) CIAAct (b)(6)
238	Acceptance Trials of Anti-Personnel Device, Footshooter		8/21/45	
239	Rocket Launcher. (MRL Projects 202, 273, 286 - Final Report)		8/25/45	
240	Delay Fuze for Spigot		8/28/45	
None	Manual of Instructions for Use of T. W. Device		No date	
None	Homemade Time Delay Incendiaries		2/28/45	
None	Memorandum Progress Report Contract OEMsr-955 - Establishment and Operation of Maryland Research Laboratories		7/12/44	
None	Establishment and Operation of Maryland Research Laboratories - Final Report to OSRD	[redacted]	6/15/45	(b)(3) CIAAct (b)(6)

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APPENDIX B

MARYLAND RESEARCH LABORATORIES REPORTS
(Listed according to SAC problem numbers)

SAC No.	Reports
1	None
2	None
3	MRL Report No. 91
3 (Adhesive)	MRL Reports Nos. 23, 51, 54, 62, and 130
3 (Magnets)	MRL Reports Nos. 5 and 12
3 (Pin-UP)	MRL Reports Nos. 4, 72, 105, 119, 147, 161, 162, 171, 171A, 182, and 236
4	MRL Report No. 10
4 (Lost Chord)	MRL Report No. 3
4 (Parachute)	MRL Reports Nos. 3, 33, 169, and 214
5	None
6	MRL Reports No. 29, 45, 138, 145, 153, 153A, 164, 176, 178, 214, and 215
6 (Arson)	MRL Reports Nos. 71, 190, 215, and 216
6 (City Slicker)	MRL Reports Nos. 53, 83, 86, 127, 144, 163, and 163A
6 (Matchhead)	MRL Reports Nos. 35, 43, 70, 74, 98, 116, 157, and 184
6 (PI)	MRL Reports Nos. 26, 28, and 28A
7	None
8	MRL Reports Nos. 27, 59, 71, 73, and 131
9	MRL Reports Nos. 143 and 143 Supplement
10	MRL Reports Nos. 16A, 16B, 16C, 16D, 36, 36A, 36B, 36C, 61, 139, 150, 150 Supplement, 160, 164, and 199
10 (Fountain)	MRL Report No. 40
10 (Mole)	MRL Report No. 2
10 (Odometer)	MRL Report No. 149
10 (Sympathetic Fuse)	MRL Reports Nos. 97, 110, 170, 189, 218, 231, 225, and 235
11	None
12	None
13	None
14	MRL Reports Nos. 3, 10, 48, and 155
15	MRL Reports Nos. 100 and 239
16	MRL Reports Nos. 60 and 77
17	MRL Reports Nos. 80A, 84, 203, 205, 207, 209, 211, 212, 215, 216, and 230
17 (AC)	MRL Reports Nos. 34, 44, 104, 108, 109, 122, 123, 159, 186 and 187
17 (Clockwork)	MRL Reports Nos. 80, 193, and 198
17 (Pencil)	MRL Reports Nos. 1, 18, 20, 20A, 21, 21A, 24, 25, 31, 39, 49, 52, 55, 57, 58, 75, 76, 89, 96, 114, 115, 117, 120, 124, 142, 153, 172, and 228

SAC No.	Reports
18	None
19	MRL Reports Nos. 37 and 95
20	None
21	MRL Reports Nos. 3, 10, 16C, 30, 38, 69, 69A, 69B, 87, 87A, 101, 118, 132, 156, 156A, 191, 210, 213, and 237
22	None
23	MRL Report No. 126
23 (Hedy)	MRL Report No. 10
23 (Who, Me?)	MRL Reports Nos. 81, 107, 134, and 158
24	None
25	MRL Report No. 42
26	None
27	MRL Reports Nos. 79, 112, 135, 136, 166, 177, and 185
28	MRL Reports Nos. 47, 65, 78, 99, 106, 129, 140, 174, 217, 224, and 225
29	None
30	MRL Reports Nos. 56, 82, 88, and 94
31	MRL Report No. 71
31 (Lulu)	MRL Reports Nos. 92, 152, 167, 180, and 183
31 (Teak)	MRL Reports Nos. 63 and 93
32	None
33	MRL Reports Nos. 46, 66, 113, 179, 192, 194, and 197
34	None
35	None
36	MRL Reports Nos. 90, 201, 220, and 240
37	None
38	MRL Reports Nos. 67, 68, 137, 139, and 148
38 (Nemo)	MRL Report No. 42
39	None
40	MRL Report No. 125
41	MRL Report No. 111
42	MRL Reports Nos. 6, 6A, 6B, 14, 15, 17, 85, 165, 175, 181, and 221
43	MRL Reports Nos. 128 and 200
44	None
45	None
46	None
47	MRL Reports Nos. 173, 188, and 202
48	MRL Reports Nos. 13, 22, 50, 64, 91, 117, 121, 126, 131, 144, 170, 172, 187, 198, 204, and 208
49	MRL Reports Nos. 149 and 151
50	None
51	MRL Reports Nos. 219 and 232
52	None
NS-164	MRL Report No. 154
Miscellaneous Reports:	MRL Reports Nos. 7, 8, 9, 11, 19, 19A, 29, 32, 41, 84, 102, 103, 133, 141, 146, 168, 195, 196, 222, 223, 233, 234, 238

APPENDIX C

INDEX OF CONTRACTORS' FINAL REPORTS TO DIVISION 19

Serial No. 1

Title: The [redacted] Electrolytic Cell
Contract: OEMsr-824 [redacted]
Date: July 13, 1943

(b)(3) NatSecAct

Serial No. 2

Title: Final Report on Project Now
Contract: OEMsr-602 [redacted]
Date: August 16, 1943

(b)(3) NatSecAct

Serial No. 3

Title: The Design and Development of a Spring Energized Projectile Impeller of the Pistol Type
Contract: OEMsr-704 [redacted]
Date: September 2, 1943

(b)(3) NatSecAct

Serial No. 4

Title: Improvement of Limpet Magnets
Contract: OEMsr-1012 [redacted]
Date: November 25, 1943

(b)(3) NatSecAct

Serial No. 5

Title: Final Report - Part I, An Investigation on Silencers for Small Arms
Contract: OEMsr-906 [redacted]
Date: January 3, 1944
Note: Part II of this report is Serial No. 11.

(b)(3) NatSecAct

Serial No. 6

Title: Final Report on the Firefly Unit
Contract: OEMsr-997 [redacted]
Date: January 4, 1944

(b)(3) NatSecAct

Serial No. 7

Title: Development and Production of Aunt Jemima
Contract: OEMsr-1027 [redacted]
Date: March 10, 1944

(b)(3) NatSecAct

Serial No. 8

Title: Shortstop
Contract: OEMsr-1056 [redacted] (b)(3) NatSecAct
Date: March 10, 1944

Serial No. 9

Title: Part I - Development of Photo-Electronic Detonator for Tunnel Operation
Part II - Electro-Mechanical Switch for Track Operation
Contract: OEMsr-1238, LI Symbol 3771 [redacted] (b)(3) NatSecAct
Date: March 29, 1944

Serial No. 10

Title: Final Report on Radio Switch R-37 ( )/CR
Contract: OEMsr-739 [redacted] (b)(3) NatSecAct
Date: May 15, 1944

Serial No. 11

Title: An Investigation on Silencers for Small Arms - Part II
Contract: OEMsr-906 [redacted] (b)(3) NatSecAct
Date: June 17, 1944
Note: Part I of this report is Serial No. 5

Serial No. 12

Title: Part I - An Audible Device for Locating Canisters Dropped from Planes
Part II - A Short-Range Induction-Field Communicating System (including an Appendix A)
Part III - Report on Miscellaneous Device
Part IV - A System of Short-Range Communication by Passing Audio-Frequency Electric Currents through Water
Part V - Microwave Transmitter Receiver or Relay Station for Radio-telephone and Radiotelegraph Use
Contract: OEMsr-922 [redacted] (b)(3) NatSecAct
Date: Part I, June 12, 1944; Part II, June 1945; Part III, June 1945; Part IV, June 1945; and Part V, June 1945

Serial No. 13

Title: Final Report - Project 13.4 - 96A, Secret Means for Radio and Wire Communications
Contract: OEMsr-1183 [redacted] (b)(3) NatSecAct
Date: June 16, 1944

Serial No. 14

Title: Summary of Research on Limpet Adhesives and Suction Cup from August 1943 to March 1944
Contract: OEMsr-1072 [redacted] (b)(3) NatSecAct
Date: June 23, 1944

Serial No. 15

Title: Part I - Sabotage of Automotive Equipment
Part II - Sabotage of Cutting Fluids
Contract: OEMsr-896 [redacted] (b)(3) NatSecAct
Date: Part I, August 14, 1944; Part II, August 14, 1944

Serial No. 16

Title: Final Report on Contract [redacted]
Contract: OEMsr-1102 [redacted] (b)(3) NatSecAct
Date: September [redacted]

Serial No. 17

Title: Part I - Silent, Flashless Weapons (Rubber as Propellant)
Part II - Silent, Flashless Weapons (Rubber as Propellant)
Contract: OEMsr-924 [redacted] (b)(3) NatSecAct
Date: Parts I [redacted] November 16, 1944

Serial No. 18

Title: Final Report on Contract [redacted]
Contract: OEMsr-1173 [redacted] (b)(3) NatSecAct
Date: November 28, 1944

Serial No. 19

Title: Synthetic Fibers for Special War Uses
Contract: OEMsr-1325 [redacted] (b)(3) NatSecAct
Date: December 4, 1944

Serial No. 20

Title: Adhesives for Special Army and Navy Uses (Including Appendix A and Appendix B)
Contract: OEMsr-850 [redacted] (b)(3) NatSecAct
Date: December 6, 1944

Serial No. 21

Title: Completion Report - Development Program for Anemometers - SAC-27 - Mark I and Mark II
Contract: OEMsr-1074 [redacted] (b)(3) NatSecAct
Date: December 26, 1944

Serial No. 22

Title: Part I - Hedy; Part II - Locust; Part III - Balsam; Part IV - Fantasia; Part V - Limpet; Part VI - Who, Me? (Including Supplement); Part VII - Dog Drag; Part VIII - WP Beano; Part IX - Teak
Contract: OEMsr-1023 [redacted] (b)(3) NatSecAct
Date: Parts I, II, and III - December 27, 1944; Parts IV, V, and VI - February 5, 1945; Part VII - April 30, 1945; Part VIII - September 5, 1945; Part IX - September 24, 1945

Serial No. 23

Title: Final Report on Contract [redacted]sion Detonato (b)(3) NatSecAct
Contract: OEMsr-927 [redacted]
Date: January 1, 1945

Serial No. 24

Title: Final Rep[redacted]545
Contract: OEMsr-545 [redacted] (b)(3) NatSecAct
Date: December 22, 1944

Serial No. 25

Title: Final Report on Contract OEMsr-577 on Silent, Flashless Missile Weapons (with Rubber Propellant) - THE PENETROMETER (Project SAC-13)
Contract: OEMsr-577 [redacted] (b)(3) NatSecAct
Date: December 30, 1944

Serial No. 26

Title: The Development of a Tree and Plate Mounted Spigot Mortar
Contract: OEMsr-1279 [redacted] (b)(3) NatSecAct
Date: February 13, 1945

Serial No. 27

Title: Final Report on Cont[redacted]
Contract: OEMsr-1253 [redacted] (b)(3) NatSecAct
Date: March 3, 1945

Serial No. 28

Title: Final Repor[redacted]
Contract: OEMsr-1119 [redacted] (b)(3) NatSecAct
Date: March 10, 1945

Serial No. 29

Title: Final Report on the [redacted]
Contract: OEMsr-1349 [redacted] (b)(3) NatSecAct
Date: March 31, 1945

Serial No. 30

Title: Part I – Messenger Pouch Destroyer; Part II – The City Slicker and The Paul Revere; Part III – Pyrofilm and Its Applications; Part IV – The Manual on Arson
Contract: OEMsr-1214 [redacted] (b)(3) NatSecAct
Date: Part I – May 30, 1945; Parts II and III – May 28, 1945; Part IV – May 1945

Serial No. 31

Title: Final Report on Time Delay Controls
Contract: OEMsr-876 [redacted] (b)(3) NatSecAct
Date: July 15, 1945

Serial No. 32

Title: "Beano" An [redacted]
Contract: OEMsr-1254 [redacted] (b)(3) NatSecAct
Date: July 31, 1945

Serial No. 33

Title: Part I – Silent Weapon, the William Tell; Part II – Silent Weapon, the Bigot
Contract: OEMsr-1341 [redacted] (b)(3) NatSecAct
Date: Part I – May 5, 1945; Part II – June 12, 1945

Serial No. 34

Title: Establishment [redacted]search Laboratories
Contract: OEMsr-95 [redacted] (b)(3) NatSecAct
Date: June 15, 1945

Serial No. 35

Title: Part I – The Reduction of Noise; Part II – Sound Level Reduction in Johnson Sea Horse [redacted]
Contract: OEMsr-1427 [redacted] (b)(3) NatSecAct
Date: Part I – July 18, 1945; Part II – July 30, 1945

Serial No. 36

Title: Final Progress Report on Contract OEMsr-1215 (Appendix: "A Summarizing Report on Project Casey Jones" by [redacted] (b)(3) CIAAct (b)(6)
Contract: OEMsr-1215 [redacted] (b)(3) NatSecAct
Date: September 1945

Serial No. 37

Title: The Reduction of Noise from Outboard Motors
Contract: OEMsr-1427 [redacted] (b)(3) NatSecAct
Date: July 31, 1945

APPENDIX D

CONCLUSION

The contributions of Division 19 to the War Effort depended almost entirely on the contributions made by the organizations which it served, the Office of Strategic Services and SOE.

The following released articles are thought to be of value in indicating this point.

C O P Y

C O P Y

RELEASE FRIDAY A.M.'s
9/14/45

Office of Strategic Services
EXecutive 6100, Ext. 701
Unclassified Report
Aid to Resistance

A secret army of several thousand heroic volunteers--American soldiers, sailors, marines, civilians and foreign nationals--operated successfully behind German and Japanese lines throughout United States participation in World War II.

This army was organized and directed by the Office of Strategic Services, and operated under the various theatre commanders.

It supplied inspiration, leadership and assistance from the United States to the conquered peoples of Europe and Asia.

It delivered over 27,000 tons of American food, clothing and weapons worth many millions of dollars to the underground armies.

It helped to train and lead the resistance forces and coordinated their activities with allied military plans to speed victory and liberation of the conquered countries at a tremendous saving in allied lives.

For the first time in our military history an American army fought on untried fronts with novel tactics. Its theatre of operations was "behind the enemy lines". All enemy occupied territory was its front. It worked and fought in France, Belgium, Holland, Denmark, Norway, North Africa, Italy, Greece, Yugoslavia, Albania, Austria, Czechoslovakia, Burma, Siam, China and French Indo-China.

The secret army operated not as a large unit but in small groups of from two to thirty members. Frequently, however, they operated with larger underground forces which they trained and helped to lead in harassing attacks against the Jap and German rear. They attacked enemy

troops and destroyed bridges, roads, trains, vehicles, communications, power lines, vital factories and military installations. The bulk of the large scale fighting in the enemy rear was done by the patriot underground forces with whom the Americans worked.

The members of the army penetrated enemy territory by dangerous night and day parachute drops, by submarine and small boats and overland through the lines. Some even landed in small planes at hidden airfields. Each unit carried a radio for communication with OSS headquarters in the theatre.

The secret army rescued several thousand American airmen shot down in enemy territory.

It supplied pertinent military information on our enemies to the allied command in the various theatres of war. In many instances it was the only source of such vital information. It reported on enemy strong points, movements and identity of troops, enemy plans, defenses, a strength of resistance forces and any other information the allied command requested. It supplied the allied air forces with thousands of important bombing targets and frequently reported on the results of our bombing attacks.

At times members of this secret army found it necessary to be out of uniform. Because of the nature of their work, they were subject to torture and death if caught by the enemy. They were relentlessly hunted by the Gestapo, the Japanese secret police, and enemy troops. Hundreds were caught, tortured, and executed, but the great majority accomplished their dangerous mission.

Their contributions to the allied victory is best measured in the words of the various allied commanders whose campaigns they aided.

Of the secret army's work in the European theatre, General Dwight D. Eisenhower stated on May 31, 1945, in a letter of commendation to the Commanding Officer of OSS in the United Kingdom:

"In no previous war, and in no other theatre during this war have resistance forces been so closely harnessed to the main military effort."

"While no final assessment of the operational value of the resistance has yet been completed", Eisenhower wrote, "I consider that the disruption of enemy rail communications, the harrassing of German road moves and the continual and increasing strain placed on the German war economy and internal security services throughout occupied Europe by the organized forces of the resistance, played a very considerable part in our complete and final victory."

In Italy, too, the men of the secret army won high praise. General Mark Clark, in a letter to the Commanding Officer of the OSS 2671 Special Reconnaissance Battalion said, ".....the tasks of the men of this company was a difficult one as they were constantly pursued and harried by the enemy forces. With the knowledge that, if captured, they would probably be tortured and executed by the enemy, these men volunteered for those extra hazardous missions. The outstanding success of partisan operations in the areas where these men operated and the excellent intelligence as to enemy dispositions received, was, in large measure, due to the presence of these men and their leadership of Partisan formations."

In a captured enemy document dated October 1, 1944, Field Marshall Albert Kesselring, German C-inC, Southwest, took note of these actions as follows:

"Partisan activity in the Italian areas has constantly increased recently and partisans have appeared in areas which were hitherto practically free of them. Supply traffic is severely handicapped, and acts of sabotage become more and more frequent. This post must be countered with every available means in the interests of supplying the fighting troops and allowing the potential war effort of German occupied Italy to be utilized to the full.

"As first measure", Kesselring's order continues, "I therefore order the execution of an 'Anti-Partisan Week' from October 8th-14th. As part of this effort large scale actions will be undertaken in the areas chiefly infested by bands, while local actions will be carried out in the remaining areas on a smaller scale by troops stationed in the district."

The missions of the secret army varied with the job to be done.

One commando-type unit, known within the Office of Strategic Services as "Operational Groups", jumped into battle in groups of from ten to thirty. Their mission was nearly always the destruction of key plants, the cutting of railways and roads. Fourteen such teams, numbering 13 enlisted men and 2 officers each dropped into Southern France. Another eleven teams, of over 150 Americans, dropped into Italy. Many of these same men later did similar work in Burma and China.

Another form of mission within the secret army consisted of soldiers in groups of from two to four who went behind the enemy lines, to act as liaison with partisan armies, and to provide them with a contact to the Allied Command. These groups also performed destruction of key targets.

One of the biggest units in the secret army, known by the code name "Jedburgh", was an international group consisting of American, British, French, Belgian, Dutch and Polish soldiers. Divided into teams of three, one American or British officer, one officer from one of the Allied nations, and an American or British wireless operator, these men parachuted into France, Belgium and Holland before and after D-Day to organize and arm the resistance armies. There was hardly a marqui resistance group in France or the Lowlands which did not have its "Jedburgh" team.

Not all OSS men worked in groups. One captain, working alone, failed in a daring attempt to blow up a main road in the Brenner Pass in Italy, was caught by the Gestapo, tortured and killed, though not before he had destroyed an important high way leading into the Brenner. Another American soldier parachuted into France on D-Day and, after organizing a marqui band, passed through the German lines with the complete plans of the defenses of St. Nazaire.

In Burma the achievements of the secret army make one of the great stories of the war. From February, 1943, to July, 1945, at a cost of 15 Americans and 184 natives killed, the OSS-trained-and-led guerilla forces accounted for 5,447 Japs killed and 64 captured. They destroyed 51 bridges, 9 railroad trains, 277 military vehicles and rescued 232 airmen. The greatest total of American personnel engaged in this activity was 131 officers and 418 enlisted men with a force of 9200 natives.

During this period 6275 tons were dropped by parachute to the underground forces in Burma and Thailand. Five hundred and fifty men were also parachuted into the jungle.

Major William E. Cox, Assistant Chief of Staff G-2 North Combat Area Command, in a letter to the Commanding General of that Command dated 16 June 1945 credited the OSS detachments in Burma through their underground contacts with supplying "from 50% to 70% of all combat information received by G-2, NCAC up until 15 March 1945 and from that date until the present with 100% of combat information received. Needless to say such information was of the utmost importance to the successful operations of combat units of this command."

"In addition to accomplishing intelligence functions outlined above," Major Cox wrote, "Detachment 101 (the OSS unit), composed of American officers and enlisted men trained, equipped and led backward native tribesmen in highly successful guerilla operations which disrupted Japanese communications behind their own lines and caused them casualties of 6,000 dead plus uncounted wounded."

The same letter credited the troops of the Burma secret army with "forcing the 56th Japanese division, an experienced, battle-hardened unit of at least 5,000 combat troops to move over 170 miles southward and in so doing recovered 13,600 square miles of enemy occupied terrain with no aid from any other allied groun. rces."

In China the American secret Army joined forces with Chiang Kai Shek's guerillas and at the close of the Asiatic war were killing an average of 150 to 200 Japs a day deep behind Japanese lines.

OSS paratroopers trained and led the Chinese commandos whom General Wedemeyer credited with disrupting Japanese communications in conjunction with Russia's attack in Manchuria.

Supplying the huge underground armies was a tremendous part of the work of the Office of Strategic Services and its secret army. Parachute and clandestine shipping were the principal methods. Together with a similar British organization and in cooperation with the U. S. Army Air Force, the RAF, the American and British navies it furnished nearly all the material for the world-wide resistance forces.

About twenty thousand tons of the total dispatch to the resistance was dropped by parachute. Food, arms and clothing were packed in containers nearly six feet long, each of which could hold over 300 pounds. From OSS packing stations the containers were transported to nearly airfields, and flown over enemy territory by the United States Army Air Forces, and the RAF.

To ensure that the supplies actually reached the resistance forces, OSS military personnel parachuted behind the lines to meet resistance leaders, contacted their home bases by radio, and arranged the time and place for the dropping of supplies.

Most of the operations took place at night, and flares and flashlights were used as ground signals. When ever possible, soldiers in OSS who knew the exact dropping zone, accompanied the pilot on his mission and gave the signal for the containers to be dropped.

The secret missions reached a peak month after D-Day, in July of 1944 when over a thousand tons were dropped to the French underground who were by that time harrassing the German Army throughout the whole of France.

Here are the figures for supplies which were parachuted into Europe during 1944 alone:

France	- 3,055 tons	Denmark	- 9 tons
Poland	- 3,335 tons	Norway	- 551 tons
Belgium	- 95 tons	Holland	- 15 tons
		Yugoslavia	- 1,745 tons

In addition between April, 1944, and April, 1945, 2,425 tons were dropped to the Partisan bands in Italy who were fighting the Germans north of the Po. Small amounts also went by parachute to Greece.

Most of the food packed in the containers was American, but some of the equipment and clothing was of British manufacture.

Another ten thousand tons of equipment reached the underground through OSS clandestine shipping operations. Beginning in October, 1943, and continuing until April, 1944, a fleet of twenty-five small Yugoslavian ships, manned by Partisans under the direction of American soldiers and sailors in the Office of Strategic Services furnished partisans with most of the equipment for their 30,000 men.

While Tito was pinning down an estimated four German divisions in Yugoslavia, the OSS fleet brought him 18,000 rifles, 33 mortars, 20 field pieces, 659 machine guns, 165,775 hand grenades, and thousands of bales of overcoats and GI shoes.

None of the ships was larger than ninety-five tons. They operated between Bari in Italy and the island of Vis on the Dalmatian coast through a safe lane marked off by the RAF. Each ship arrived at Vis at 3:00 AM, was unloaded by Tito's men, hid up during the day in protected coves, and made the return journey at night.

From October, 1943, until January, 1944, the OSS fleet delivered 6,500 tons of supplies to Marshal Tito. After that, until April 1945 when the supply job was taken over by the British OSS and a British supply organization operated jointly, delivering 5,500 more tons.

Similar OSS clandestine fleets operated into Greece and Norway. Two thousand, forty-two tons were brought into Greece by boat and a smaller amount reached the resistance in Norway.

Submarines and Catalina flying boats carried many tons to Thailand and Burma but the great bulk of supplies in Southeast Asia and China were delivered by parachute.

The final achievements of the secret American army was one of mercy as teams who were standing by to drop in to hit the Japs parachuted instead to prisoner-of-war camps and made the arrangements for the rescue of thousands of Americans, including General Wainwright and the Doolittle airmen in China.

The men of the secret army were all volunteers who requested "hazardous duty behind the enemy lines". Their lives were at all times dependent upon the strictest security.

With many recommendations still in process, they have already won 941 military decorations, including 39 Distinguished Service Crosses and 65 foreign decorations.

EXCERPT FROM "THE SHADOW ARMY"

"The New York Times Magazine," October 7, 1945, page 39

"The development of special weapons and equipment by OSS, frequently with the assistance of the Office of Scientific Research and Development, is deserving of a story in itself. Thus far the details of this work are still "classified information." However, it is possible to suggest that such a story would include a description among scores of a seemingly innocuous little gadget no larger than a three-inch pencil stub, which was found useful in blowing out the brains of prison guards and sentries. It would include spectacular developments in explosives; some that can be worked like putty to cling to a steel girder and others so cleverly camouflaged as to be mistaken for quite ordinary articles of commerce. It would include time fuses of amazing intricacy and seemingly human intelligence and pocket-size incendiaries capable of incredible destructiveness.

"Such a story would certainly include something about the 'Woolworth .45,' a weapon as deadly as an Army automatic but mass-produced at a cost of less than $1.50 each. Packed in six-inch cardboard cartons with ten rounds of ammunition, they were parachuted by the tens of thousands to partisans throughout Europe and Asia.

"Not too dependable after twenty or thirty firings, the 'Woolworth .44' nevertheless found great favor, particularly among the French Maquis and the partisans of Yugoslavia. They cherished it as 'a great gun to get another gun with,' which usually meant the Luger or Panzerfause of a dead Nazi.

"At midnight, September 30, OSS ceased to exist as an independent entity. Its intelligence functions were taken over by the State Department, its weapons and other special devices were turned over to Army Ordnance, its people, 'know how' and incomparable esprit de corps were dispersed on the turbulent winds of reconversion.

"There had been hope among those highly placed in OSS that its work would be continued into peacetime, that the worth of an agency equipped to collect foreign information by stealth if necessary and to correlate it in a pattern of maximum usefulness with other intelligence of whatever nature and origin had been proved.

"But the contrary turn of events has left them with no bitterness or reproach. The 'cloak and dagger boys' rest on the secure knowledge that the job they have done has been a good one and a valuable one, and, as one of them put it recently, 'We got a hell of a kick out of doing it.'"